OFFICER CORRESPONDENCE COURSE

PRINCIPLES OF NAVAL ENGINEERING, PART I

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PRINCIPLES OF NAVAL ENGINEERING, PART I

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This course was prepared by the Naval Education
and Training Program Development Center, Pensacola, Florida
for the Chief of Naval Education and Training

This correspondence course contains a set of assignments and perforated answer sheets and utilizes the following text: PRINCIPLES OF NAVAL ENGINEERING, NAVPERS 10788-B.

If an errata sheet comes with the course, make all indicated changes and corrections. Do not make any other changes in the textbook or assignment booklet.

HOW TO COMPLETE THIS COURSE SUCCESSFULLY

Study the textbook pages given at the beginning of each assignment before trying to answer the items. Read the learning objectives that precede the sets of items. The learning objectives and items are based on the subject matter or study material in the textbook. The objectives tell you what you should be able to do by studying assigned textual material and answering the items.

At this point you should be ready to answer the items in the assignment. Read each item carefully. Select the BEST ANSWER for each item, consulting your textbook when necessary. Be sure to select the BEST ANSWER from the subject matter in the textbook. You may discuss difficult points in the course with others. However, the answer you select must be your own.

It is recommended that the assignments be completed as quickly as possible to derive maximum benefit from the course. The student must complete at least one assignment per month to meet the requirements established by the Chief of Naval Education and Training.

You can complete this course successfully by earning grades that average 3.4 or higher. If you are on active duty, the average of your grades in all assignments must be at least 3.4. If you are NOT on active duty, the average of your grades in all assignments of each creditable unit must be at least 3.4. The unit breakdown of the course, if any, is shown later under Naval Reserve Retirement Credit.

Comments regarding this course should be submitted to the Naval Education and Training Program Development Center on the tear-out letter form in the back of this booklet.

YOUR COURSE IS ADMINISTERED BY THE NAVAL EDUCATION AND TRAINING PROGRAM DEVELOPMENT CENTER

After finishing an assignment, go on to the next. Retain each completed answer sheet until you finish all the assignments in a unit (or the course if it is not divided into units). Using the envelopes provided, mail your answer sheets to Naval Education and Training Program Development Center, Pensacola, Florida, 32559 where they will be graded and the scores recorded. Make sure all blanks at the top of each answer sheet are filled in. Unless you furnish all information required, it will be impossible to give you credit for your work. You should record your answers in the assignment booklet for reference in the event that your answers are lost in the mail or misplaced and resubmission is required for course credit. Graded answer sheets will be returned to the student only when the back of each answer sheet is filled in with the student's complete mailing address. Answer sheets received without the student's address shown on the back WILL NOT be returned. However the student will receive formal notification of final grade for the course or creditable unit, if applicable.

RESERVE RETIREMENT CREDIT

For the purpose of Naval Reserve retirement, this edition of this course is evaluated as follows: Unit 1: 12 points upon satisfactory completion of assignments 1 through 8. Unit 2: 4 points upon satisfactory completion of assignments 9 through 11.

These points are creditable only to personnel eligible to receive them under current directives governing retirement of Naval Reserve personnel. Points will be credited upon satisfactory completion of the entire course.

While working on a correspondence course, students may refer freely to open-book texts and references. They may seek advice and instruction from others on problems arising in the course, but the solutions submitted must be the result of each student's own work and decisions. The student is prohibited from referring to or copying the solutions of others or giving completed solutions to anyone else taking the same course. Noncompliance can result in suspension from the course by the administering activity and disciplinary action by Commander, Naval Military Personnel Command.

THIS COURSE IS ADMINISTERED SOLELY BY THE CENTER. ALL ENROLLEES, ACTIVE AND INACTIVE, ARE TO RETURN COMPLETED ANSWER SHEETS TO THE CENTER FOR GRANDING AND RECORDING OF ASSIGNMENTS SCORES.

You may keep the textbook and assignments for this course. Return them only in the event you disenroll from the course or otherwise fail to complete the course. Directions for returning the textbook and assignments are given on the material credit form in the back of this booklet.

COURSE OBJECTIVE

Principles of Naval Engineering, Part I is designed for use by active duty 11XX and 14XX officers, and by reserve officers with the following designators: 11XX, 13XX, 140X 151X, 153X, 170X, and selected warrant officers. These officers must acquire a general knowledge of shipboard engineering plants and an understanding of the basic theoretical considerations that underlie the design of machinery and equipment.

As the individual completes this course, they will acquire sufficient knowledge of the principles of naval engineering which, when combined with practical experience, will enable them to perform effectively in a billet requiring this knowledge. Specifically, they will demonstrate a basic knowledge of the following concepts, equipments, systems and procedures.

a. Ship design and construction; principles of stability and buoyancy, the effects of weight changes.

b. Basic concepts of damage control; organization, implementation.

c. Need for proper lubricating oils; classification, characteristics and proper care.

d. Measuring devices and their use aboard ship.

e. Fundamental concepts of thermodynamics; application aboard ship.

f. Arrangement of machinery and piping; functional interrelationships of components, modes of operation.

g. Operation of propulsion boilers; classification, types, functions, boiler water control, combustion requirements, casualty control, maintenance, fittings, safety.

h. Fundamental concepts of steam turbines; principles, classification, maintenance, casualty control.

i. Principles of operation of condensers and heat exchangers; maintenance, safety, casualty control.

Naval courses may include a variety of questions -- multiple-choice, true-false, matching, etc. The questions are not grouped by type; regardless of type, they are presented in the same general sequence as the textbook material upon which they are based. This presentation is designed to preserve continuity of thought, permitting step-by-step development of ideas. Some courses use many types of questions, others only a few. The student can readily identify the type of each question (and the action required) through inspection of the samples given below.

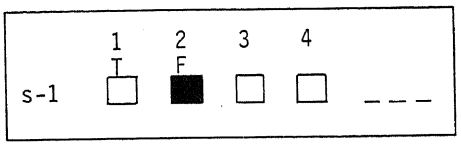
MULTIPLE-CHOICE QUESTIONS

Each question contains several alternatives, one of which provides the best answer to the question. Select the best alternative, and blacken the appropriate box on the answer sheet.

SAMPLE

s-1. The first person to be appointed Secretary of Defense under the National Security Act of 1947 was
1. George Marshall
2. James Forrestal
3. Chester Nimitz
4. William Halsey

Indicate in this way on the answer sheet:



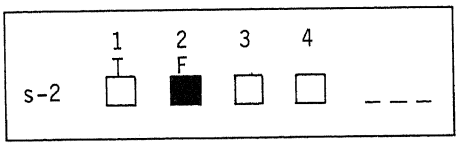
TRUE-FALSE QUESTIONS

Mark each statement true or false as indicated below. If any part of the statement is false the statement is to be considered false. Make the decision, and blacken the appropriate box on the answer sheet.

SAMPLE

s-2. Any naval officer is authorized to correspond officially with any systems command of the Department of the Navy without his commanding officer's endorsement.

Indicate in this way on the answer sheet:



MATCHING QUESTIONS

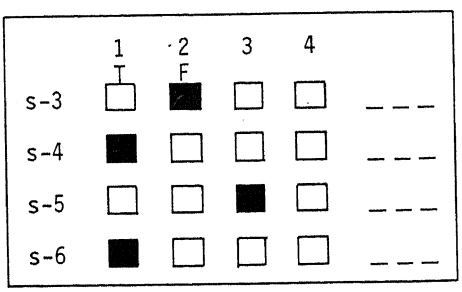
Each set of questions consists of two columns, each listing words, phrases or sentences. The task is to select the item in column B which is the best match for the item in column A that is being considered. Items in column B may be used once, more than once, or not at all. Specific instructions are given with each set of questions. Select the numbers identifying the answers and blacken the appropriate boxes on the answer sheet.

SAMPLE

In questions s-3 through s-6, match the name of the shipboard officer in column A by selecting from column B the name of the department in which the officer functions.

A	B
s-3. Damage Control Assistant	1. Operations Department
s-4. CIC Officer	2. Engineering Department
s-5. Disbursing Officer	3. Supply Department
s-6. Communications Officer	

Indicate in this way on the answer sheet:



Assignment 1

The Development of Naval Ships; Ship Design and Construction

Textbook Assignment: Pages 3 - 33

In this course you will demonstrate that learning has taken place by correctly answering training items. The mere physical act of indicating a choice on an answer sheet is not in itself important; it is the mental achievement, in whatever form it may take, prior to the physical act that is important and toward which correspondence course learning objectives are directed. The selection of the correct choice for a correspondence course training item indicates that you have fulfilled, at least in part, the stated objective(s).

The accomplishment of certain objectives, for example, a physical act such as drafting a memo, cannot readily be determined by means of objective type correspondence course items; however, you can demonstrate by means of answers to training items that you have acquired the requisite knowledge to perform the physical act. The accomplishment of certain other learning objectives, for example, the mental acts of comparing, recognizing, evaluating, choosing, selecting, etc., may be readily demonstrated in a correspondence course by indicating the correct answers to training items.

The comprehensive objective for this course has already been given. It states the purpose of the course in terms of what you will be able to do as you complete the course.

The detailed objectives in each assignment state what you should accomplish as you progress through the course. They may appear singly or in clusters of closely related objectives, as appropriate; they are followed by items which will enable you to indicate your accomplishment.

All objectives in this course are learning objectives and items are teaching items. They point out important things, they assist in learning, and they should enable you to do a better job for the Navy.

This self-study course is only one part of the total Navy training program; by its very nature it can take you only part of the way to a training goal. Practical experience, schools, selected reading, and the desire to accomplish are also necessary to round out a fully meaningful training program.

Learning Objective: Point out facts, events, and other details relating to the development of steam machinery. Textbook pages 3 through 7.

1-1. In the development of naval ships, man is essentially concerned with the
1. use of water to operate heavy machinery
2. conversion of steam into various types of power
3. conversion, use, and control of energy
4. conversion of mechanical energy to nuclear energy

1-2. One of the earliest steam machines on record is the one developed by
1. Giovanni Battista della Porta in 1601
2. Hero about 2000 years ago
3. Thomas Savery in 1698
4. Denis Papin in 1690

1-3. Which use of steam did Giovanni Battista della Porta suggest in his 1601 treatise on pneumatics?
1. Condensing steam to create a vacuum which, in turn, is used to draw water upward from a lower level
2. Letting steam escape through nozzles to displace pistons upward inside cylinders
3. Letting steam displace pistons which, in turn, force water upward through a check valve
4. Using steam as the energy source of prime movers for ships

1-4. What is the principle of operation of the steam engine patented by Thomas Savery in 1698?
1. Steam under pressure that is permitted to escape through a nozzle will create a motion that is opposite to the flow of the steam.
2. When steam is condensed, it reduces existing pressure thus creating a suction which develops a pumping action.
3. Steam under pressure acting against a movable piston will transform energy into work.
4. When steam is used to displace water and is then condensed, it creates a vacuum which develops a suction and again fills the displacement vessel with water.

1-5. The first workable steam engine that used the piston and cylinder principle was the
1. Watt engine developed in the 18th century
2. Newcomen engine developed in the 18th century
3. Savery machine developed in the 19th century
4. Hero machine developed before the 19th century

1-6. Although Papin's piston-cylinder arrangement for a steam engine was workable, what was the main reason his engine proved unsatisfactory?
1. He tried to generate the steam in the bottom of the cylinder.
2. He tried to generate the steam in the top of the cylinder.
3. He provided no means for rapid condensation.
4. He separated the boiler from the cylinder of the engine.

1-7. The Newcomen engine differed from the engine proposed by Papin in that the former
1. generated the steam in the bottom of the cylinder
2. uses steam pressure for both the upward and downward strokes of the piston
3. had the boiler and engine cylinder together as a unit
4. had the boiler separated from the engine cylinder

1-8. In the operation of the engine illustrated in figure 1-1 of the textbook, atmospheric pressure is used to
1. condense the steam
2. maintain a partial vacuum
3. move the piston downward
4. lift water upward

1-9. The Newcomen engine was the first self-acting mechanism known to man.

1-10. Although James Watt started work some 50 years after the Newcomen engine was operational, Watt's ideas made possible the use of the steam engine for applications other than the pumping of water.

1-11. The principle advanced by Watt to reduce the fuel consumption of the Newcomen engine includes
1. a means for retaining the heat in the cylinder body so that the difference in temperature between the cylinder and the steam that enters it is at a minimum
2. integration of the cylinder and the condensation vessel
3. a means for retaining, or preventing loss of, air or other elastic vapor not condensed in the condenser
4. movement of the piston by suction created through the condensation of steam

1-12. By his contributions to steam engine development, Watt was first in
1. developing a device for translating reciprocating motion into rotary motion
2. applying a device to a steam engine that would convert the output into rotary motion
3. developing a workable centrifugal "flyball" governor
4. applying a reduction gear to regulate speed

1-13. What improvement was realized by adding the feedback principle to the "flyball" governor of a steam engine?
1. It made the engine automatic.
2. It made the engine more efficient by increasing its horsepower.
3. It provided the engine with the capability of increased loads with no increase in rpm.
4. It provided the engine with the capability of changing its speed in accordance with increased or decreased demands.

1-14. When and by whom was the first high pressure steam engine built?
1. 1769 by Newcomen
2. 1801 by Watt
3. 1804 by Evans
4. 1897 by Trevethick

1-15. Steam turbines were used for ship propulsion for the first time in the year
1. 1884
2. 1889
3. 1897
4. 1910

Learning Objective: Recognize facts, events, and other details relating to the development of naval surface ships and submarines. Textbook pages 7 through 14.

1-16. Which warship was the first to use steam propulsion and in which year was the ship built?
1. Fulton, 1815
2. Mississippi, 1842
3. Missouri, 1842
4. Michigan, 1843

1-17. Which ship of the steam Navy had iron boilers instead of copper boilers?
1. Mississippi
2. Missouri
3. Michigan
4. Each of the above

1-18. The Navy ship Princeton was first in each of the following respects except for being the first warship to
1. have all machinery located below the waterline
2. operate without sails
3. use screw propellers
4. burn hard coal and supply extra air for combustion

1-19. Which was the Navy's first completely steam-driven ship, and when did the Navy obtain this ship?
1. Princeton, in 1844
2. Merrimac, in 1854
3. Pensacola, in 1860
4. Wampanog, in 1867

1-20. One of the major interests in ship development during the close of the 19th century was
1. usable steam turbines
2. increased speed
3. multiblade screw propellers
4. oil-burning propulsion plants

1-21. A military disadvantage in Navy steam ships that became apparent in the early part of the 20th century resulted from
1. the use of coal as fuel
2. the use of reciprocating engines as propulsion plants
3. the use of reduction gears for speed control
4. all the above

1-22. When the steam turbine became a major prime mover for Navy ships, difference in speed between the turbine and the ship's propeller became a problem but was initially solved by the use of
1. turboelectric drives
2. reduction gears
3. centrifugal "flyball" governors
4. twin screws

1-23. What was one of the most significant improvements in steam ship development during the WWII period?
1. Perfection of turboelectric drives
2. Perfection of the geared-turbine drive
3. Increase in steaming radius
4. Increase in operating steam pressure

1-24. When did the gas turbine engine for ship propulsion become prominent?
1. Immediately after WWI
2. Just prior to WWII
3. During WWII
4. After WWII

1-25. An important advantage of the nuclear powered ship over the conventional powered ship is its
1. almost unlimited steaming radius
2. maximum obtainable speed
3. low cost of operation
4. lack of a wake at cruising speed

1-26. The first submersible craft used as an offensive weapon in naval warfare was propelled by
1. manually operated screws
2. steam engines
3. gasoline engines
4. electric motors

1-27. The first all-electric submarine was unsuccessful because its effective range was too short.

1-28. By whom and in what year was the U.S. Navy's, first submarine built?
1. Robert Fulton, in 1798
2. Campbell, in 1886
3. John Holland, in 1900
4. Bushnell, in 1917

1-29. The first Navy submarines to use diesel engines were the
1. B-boats
2. C-boats
3. D-boats
4. E-boats

1-30. By using nuclear power, the submarine is capable of almost limitless underwater endurance.

Learning Objective: Recognize factors that influence the basic design of naval ships and effects of the factors on combat efficiency. Textbook pages 15 and 16.

1-31. Although many factors must be considered in the design and construction of a naval ship, the primary consideration should be
1. cost
2. combat efficiency
3. available dockyard facilities for maintenance
4. simplicity with respect to operation and maintenance

1-32. In the design of a naval ship the prime mover must be considered with regard to
1. its location in the ship
2. its weight and the space it occupies
3. its effect on the ship's center of gravity
4. all the above factors

1-33. The speed and radius of action of a ship may be increased by
1. increasing the fraction of displacement set aside for fuel and stores
2. decreasing displacement of a ship as a whole
3. increasing displacement of a ship as a whole
4. decreasing displacement without decreasing the fraction of displacement appropriated to fuel and stores

1-34. How does the size of geometrically similar ships effect their seaworthiness?
1. Increase in size will increase their seagoing capabilities.
2. Decrease in size will increase their seagoing capabilities.
3. Medium-size ships will have the greatest seagoing capabilities.
4. Size will have no effect on their seagoing capabilities.

1-35. How does size affect the ability of ships to protect themselves against attacks by enemy ships?
1. Small ships provide more protection than do large ships.
2. Large ships provide more protection than do small ships.
3. Medium-size ships provide greatest protection.
4. Size does not affect the ability of ships to protect themselves.

1-36. The many factors that must be considered in the design of a ship are each important since improvement of one feature may weaken another.

Learning Objective: Apply principles of flotation. Textbook pages 16 and 17.

1-37. When dropped in water an object will sink if it weighs more than the weight of water it displaces.

1-38. A certain solid object weighs less than the volume of water it displaces. What will happen to the object after it is dropped into a large tank of water?
1. It will sink quickly to the bottom of the tank and remain there.
2. It will sink slowly and float completely submerged near the bottom of the tank.
3. It will rise and float in the water partly submerged.
4. It will rise and float in the water just beneath the surface, but totally submerged.

Learning Objective: Classify by type given examples of stresses. Textbook page 17.

The following alternatives are for items 1-39 and 1-40:
1. shear
2. compression
3. torsion
4. tension

1-39. When two men pull on the opposite ends of a rope, the rope is subjected to a type of stress called

1-40. If you put a wrench on each end of a steel bar and try to turn the wrenches in opposite directions, the bar is subjected to a type of stress called

Learning Objective: Identify structural members of a ship and effects of stresses on them when the ship is in a seaway. Textbook pages 17 through 26.

1-41. Strain is placed on a metal bar when it is subjected to
1. compression
2. tension
3. torsion
4. any of the above stresses

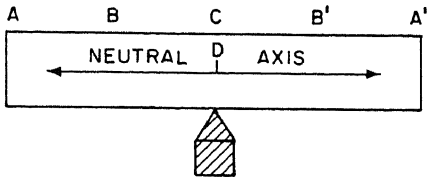


Figure 1A.-I-beam supported in center. 462

1-42. If equally heavy loads are placed at points A and A' of figure 1A, what part of the I-beam, if any, is not subjected to stress?
1. B or B'
2. C
3. D
4. None

1-43. The strength of a ship's hull is dependent upon its structural parts which include
1. the longitudinal bulkheads
2. the shell plating
3. the decks
4. all the above parts

1-44. A ship is subjected to longitudinal bending when the crest of a wave moves from
1. bow to midship
2. midship to stern
3. either bow to midship or midship to stern
4. port quarter to starboard quarter or vice versa

1-45. Certain deck areas aboard ship have thicker deck plating than the normal traffic areas to enable the ship to withstand
1. local stresses
2. transverse stresses
3. dynamic stresses
4. longitudinal bending

1-46. What parts of a ship's hull contribute most to the strength of the ship?
1. "A" strakes
2. Longitudinals
3. "F" strakes
4. Stringers

1-47. A principal strength member of a ship's hull located at the bottom and running the length of the ship is called the
1. "A" strake
2. deck stringer
3. bilge strake
4. keel

1-48. The solid vertical plate between the rider plate and the flat keel plate is called the
1. vertical keel
2. frame bar
3. collar plate
4. reverse bar

1-49. What part of a ship's hull is designed to keep the plating from bulging and buckling?
1. Girder
2. Stringer
3. Frame
4. Web

1-50. Frames that extend outward from the keel and are continuous from the keel to the main deck are said to be
1. inverted
2. longitudinal
3. transverse
4. continuous

1-51. Longitudinal frames that are cut to permit intersection with other frames are called
1. keelsons
2. transverse frames
3. intercostal girders
4. intercostal frames

1-52. In addition to strengthening ship structure the inner bottom on ships with double bottoms serves to
1. act as the foundation for mounting machinery
2. tie the stern to the outside plating
3. form the butt connection between the plates
4. protect against the effects of flooding in case of damage to the outer bottom

1-53. On a small ship, the heavy steel plate that is a continuation of the keel to the top of the bow is known as
1. a rabbet
2. the stem
3. a breast hook
4. the rider plate

1-54. The triangular-shaped plates parallel to, and between, decks that fasten together the peak frames, stem and outside plating are called
1. breast hooks
2. rabbets
3. rider plates
4. sheer strakes

1-55. The stern post of a ship is rigidly secured to
1. the shellplating
2. the decks
3. the keel
4. all the above components

1-56. What is the function of the bilge keel on a ship?
1. To reduce rolling
2. To reinforce the ships outer plating
3. To provide rigid joints for the strakes
4. To reduce local stress concentration

1-57. Which deck of a ship is its strength deck?
1. Highest weather deck
2. Lowest superstructure deck
3. Highest deck extending from stem to stern
4. Lowest deck not extending from stem to stern

1-58. Transverse members of the framing structure that support the main deck are called
1. deck longitudinals
2. hull girders
3. deck stringers
4. deck beams

1-59. Decks above the main deck of a ship usually incorporate expansion joints which serve to
1. strengthen the ship's structure
2. prevent cracking and buckling of the superstructure
3. take some of the load off the deck beam brackets and side frames
4. tie the shellplating and framing together

1-60. In the construction of large ships stanchions are provided to
1. increase the strength of load bearing beams and brackets
2. support heavy equipment
3. enable the ship to withstand longitudinal strains
4. reinforce the keel

1-61. To reinforce a ship's bulkheads against bending and bulging, the bulkheads are provided with
1. stanchions
2. stiffeners
3. girders
4. rabbets

1-62. What parts of a ship's structure provide flooding boundaries and are continuous from keel to main deck?
1. Main transverse bulkheads
2. Main longitudinal bulkheads
3. Deck stringer plates
4. Deck girders

Learning Objective: Apply systems of numbering ship compartments. Textbook pages 27 through 29.

● Items 1-63 and 1-64 refer to compartment C-411-E aboard your ship.

1-63. What is the location and use of the compartment?
1. Forward and port on Charlie deck; used for living quarters
2. Forward and starboard on Charlie deck; used for equipment storage
3. Aft and port on the fourth deck; used for the ship's machinery
4. Aft and starboard on the fourth deck; used for the ship's machinery

1-64. What is the compartment number and what are you likely to find in the compartment?
1. C; fuel
2. E; prime mover
3. 11; steering engine
4. 41; paint

● Items 1-65 through 1-67 refer to a space aboard a transport identified by the symbol 02-42-0-L.

1-65. When was the transport built?
1. Before WWII
2. During WWII
3. Before March 1949
4. After March 1949

1-66. What is the location and a possible use of the compartment?
1. In the center and aft of frame 42 on a partial deck; captain's quarters
2. In the center and forward of frame 42 on a partial deck; wheel house
3. Second compartment forward of ship's center on the fourth deck; radio shack
4. Second compartment aft of ship's center on the fourth deck; captain's quarters

1-67. What parts of the number identify the deck and primary use?
1. 02 and 0
2. 02 and L
3. 42 and 0
4. 42 and L

Learning Objective: Interpret drawing plans used in visualizing ship configurations. Textbook pages 30 through 33.

1-68. Which projection is part of the lines drawing of a ship?
1. Body plan
2. Sheer plan
3. Half-breadth plan
4. Each of the above

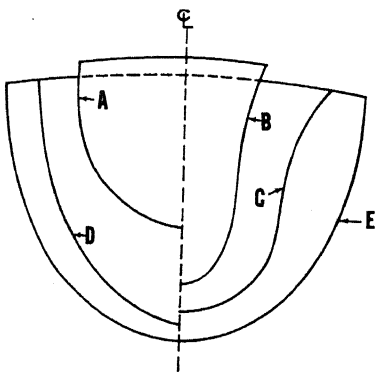


Figure 1B.-Body plan.

● Items 1-69 through 1-71 refer to figure 1B.

1-69. Which curves represent the front, center, and aft half stations, respectively?
1. A, B, C
2. A, D, E
3. B, E, A
4. B, C, E

1-70. The section on the right of the broken line represents the
1. forward section of the hull
2. after section of the hull
3. forward perpendicular
4. after perpendicular

1-71. The station known as the middle perpendicular is located at
1. A
2. C
3. D
4. E

1-72. A line that cuts a ship's hull vertically from bow to stern is known as a
1. waterline
2. diagonal
3. buttock
4. perpendicular

Assignment 2

Stability and Buoyancy

Textbook Assignment: Pages 34 - 60

Learning Objective: Recognize the basic principles of ship stability and buoyancy. Textbook pages 34 through 39.

2-1. A ball floating in water is in what state of stability?
1. Stable
2. Unstable
3. Neutral
4. Zero

2-2. Under what condition, if any, does the center of gravity and the center of buoyancy of a ship lie in the same vertical line?
1. When the ship is at even keel
2. When the ship heels to the right or left
3. Under all conditions
4. Under no conditions

2-3. A 12' x 6" x 4" plank weighing 64 pounds is thrown into sea water. How much of the plank, if any, is above the surface?
1. One fourth of its volume
2. One-half of its volume
3. Three-fourths of its volume
4. None; it floats entirely below the water's surface

2-4. A ship displacing 140,000 cubic feet of sea water weighs about
1. 63 tons
2. 70 tons
3. 2,200 tons
4. 4,000 tons

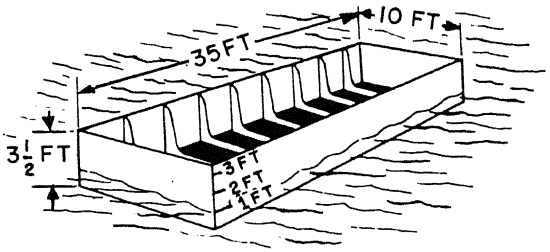


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Figure 2A.

2-5. When the rectangular barge of figure 2A floats empty in sea water, its waterline is at the 1-foot mark. How much does the empty barge weigh?
1. 3.5 tons
2. 10 tons
3. 25 tons
4. 35 tons

2-6. What is the approximate reserve buoyancy of the barge in figure 2A when it is carrying cargo and displacing 30 tons?
1. 35 cu ft
2. 175 cu ft
3. 700 cu ft
4. 1,050 cu ft

2-7. Refer to textbook figure 3-4. If the displacement is 18,000 tons, what is the mean draft?
1. 24 ft
2. 26 ft
3. 28 ft
4. 30 ft

2-8. The height of the center of buoyancy of a certain ship floating at a mean draft of 17 feet is 9.5 feet. Using textbook figure 3-6, find the approximate mean draft when KB is 12.5 feet.
1. 14 ft
2. 16 ft
3. 20 ft
4. 22 ft

2-9. Assume that after loading, the barge in figure 2A weighs 20 tons. What is its freeboard?
1. 1 1/4 ft
2. 1 1/2 ft
3. 2 ft
4. 2 1/2 ft

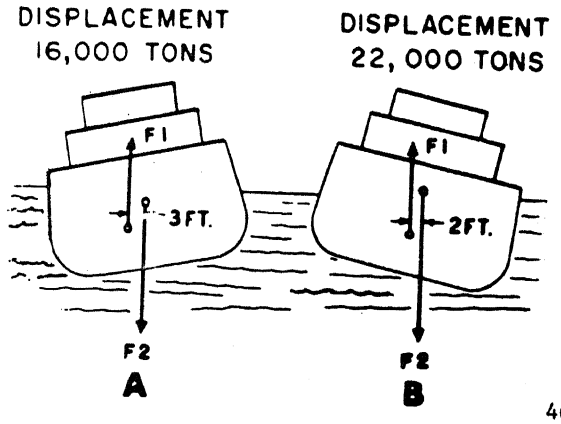

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Figure 2B.

● Items 2-10 through 2-12 refer to figure 2B.

2-10. What is the value of the moment in part B?
1. 22,000 ft-tons
2. 38,500 ft-tons
3. 44,000 ft-tons
4. 60,500 ft-tons

2-11. Which of the following conditions are shown in Part A of figure 2B?
1. A clockwise righting moment
2. A counterclockwise righting moment
3. Counterclockwise and clockwise righting moments
4. Counterclockwise and clockwise upsetting moments

2-12. Which of the following conditions is demonstrated in Part A of figure 2B?
1. A righting moment of 44,000 ft-tons
2. A righting moment of 48,000 ft-tons
3. A righting moment of 22,000 ft-tons
4. An upsetting moment of 48,000 ft-tons

2-13. Refer to textbook figure 3-10. The metacentric radius of the ship when upright is the distance between M and
1. the waterline
2. B1
3. B2
4. the keel at the centerline

2-14. At the exact instant a ship is heeling 30 degrees (sin 30° = 0.5000) its righting arm is equal to
1. one-half its metacentric height
2. its metacentric height
3. twice its metacentric height
4. its metacentric radius

2-15. Which set of conditions exists in an unstable ship?
1. GM is positive, the moments are righting moments, and M is above G.
2. GM is positive, the moments are upsetting moments, and G is above M.
3. GM is negative, the moments are upsetting moments, and M is below G.
4. GM is negative, the moments are righting moments, and G is below M.

2-16. Assume that two sister ships, A and B, are both listing 10 degrees to port. If ship A feels stiff and ship B feels tender, then ship A is likely to have a
1. lower resistance to damage
2. poorer initial stability
3. larger GZ and larger GM
4. longer period of roll

2-17. The forces acting on a combatant ship with high metacenter have an adverse effect on the forces associated with
1. maneuvering the ship
2. trimming the ship
3. firing the ship's guns
4. maintaining the ship's stability

Learning Objective: Determine the effects of increased displacement and angle of heel on ship stability, using stability curves where applicable. Textbook pages 39 through 43.

2-18. Refer to textbook figure 3-12. At approximately what angle of heel is the value of GZ greatest?
1. 10°
2. 30°
3. 40°
4. 60°

2-19. Where are the positions of B and G located in relation to the centerline of a ship at even keel?
1. They are located on opposite sides of the centerline.
2. They are located on the centerline.
3. G is on the centerline, B is off.
4. B is on the centerline, G is off.

2-20. When a ship is underway in rough waters, you must consider several factors before you can determine the size of its righting arm by using the equation GZ=GM x sin Θ. Which of the following factors relevant to the equation does not change?
1. Angle of heel
2. Center of gravity
3. Center of buoyancy
4. Shape of ship's underwater body

2-21. As a ship inclines from 0 to 10 degrees, how do the positions of B and G move with respect to the centerline of the ship?
1. G moves off the centerline, B does not.
2. B moves off the centerline, G does not.
3. Both B and G move off the centerline.
4. Neither B nor G moves off the centerline.

2-22. An increase in draft changes the distance between a ship's center of gravity (G) and its center of buoyancy (B). When the ship heels, what effect does the change between G and B have on the length of the righting arm (GZ)?
1. GZ is longer because the distance GB is shortened.
2. GZ is longer because the distance GB is lengthened.
3. GZ is shorter because the distance GB is shortened.
4. GZ is shorter because the distance GB is lengthened.

2-23. When a large weight is loaded on a ship causing a change in the righting arm, the stability of the ship is changed. Are there certain conditions under which these changes in displacement and righting arms may result in increased stability?
1. Added weight always increases overall stability
2. When the righting moments remain the same
3. When the righting moments are increased
4. Reduced righting arms always decrease overall stability

● For items 2-24 and 2-25 refer to figure 3-14 of the textbook and assume that the USS Middletown is displacing 10,000 tons and has an actual KG of 20 feet.

2-24. What change occurs in the size of righting arms as the cruiser heels from 10 to 20 degrees?
1. Increases from 1.6 ft to 2.6 ft
2. Increases from 1.6 ft to 3.1 ft
3. Decreases from 2.6 ft to 1.6 ft
4. Decreases from 3.1 ft to 1.6 ft

2-25. What is the cruiser's approximate righting moment when the angle of heel is 10 degrees?
1. 16,000 ft-tons
2. 20,000 ft-tons
3. 26,000 ft-tons
4. 31,000 ft-tons

2-26. Deleted.

2-27. Refer to textbook figure 3-14 and assume that the USS Middletown is displacing 12,500 tons and has an actual GK of 22 feet. At a 30-degree angle of heel, the cruiser's righting arm is about
1. 2.2 ft
2. 3.0 ft
3. 4.0 ft
4. 5.0 ft

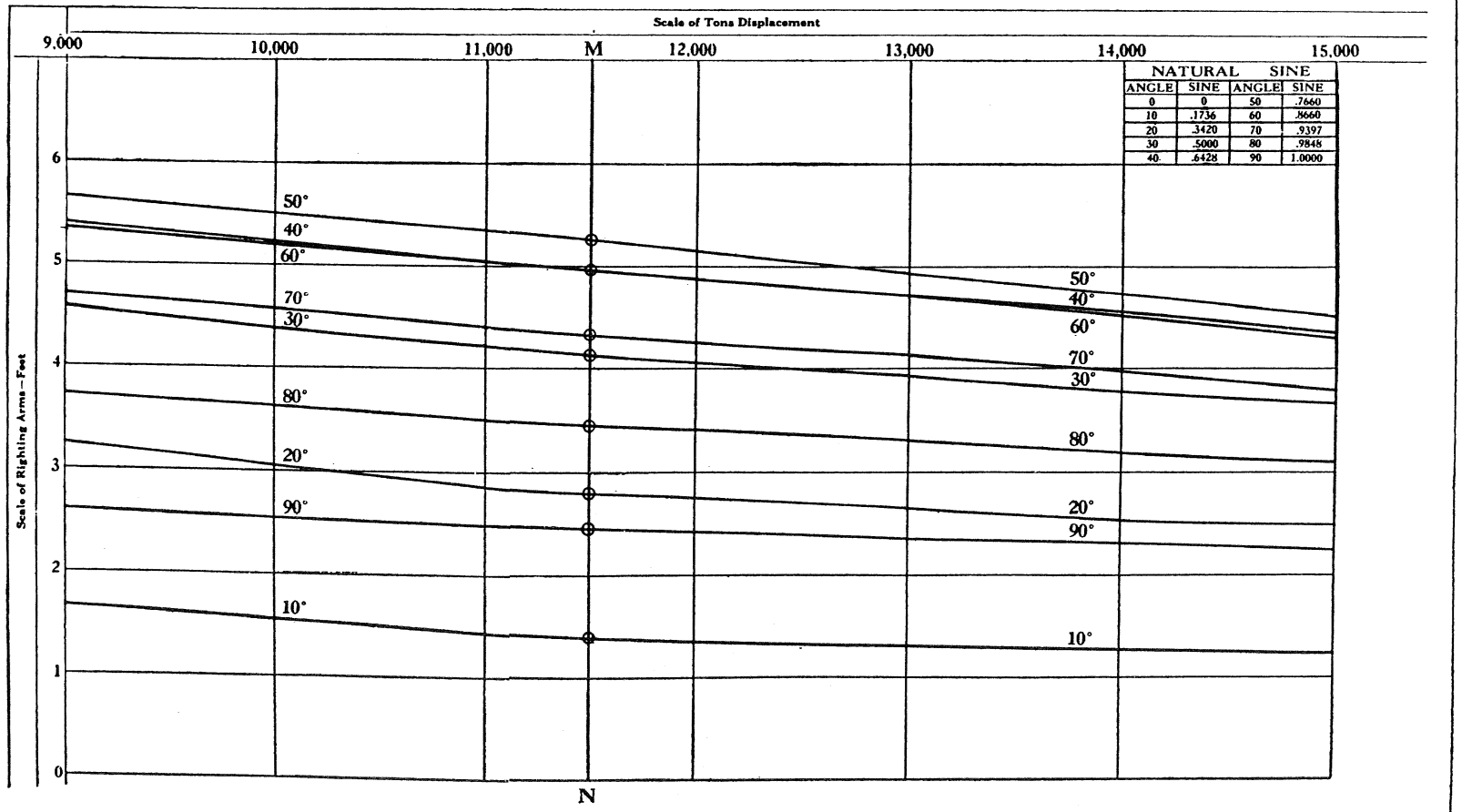
N. B. S. 2029-10

INCLINING EXPERIMENT, U. S. S. MIDDLETOWN [Sheet 18 of 42]

CROSS CURVES OF STABILITY

Axis assumed 20 **feet above base line**

Vessel considered water-tight to FORECASTLE DECK **Taken from Plan No.** ..... **BuShips No.** .....



NATURAL SINE			
ANGLE	SINE	ANGLE	SINE
0	0	50	.7660
10	.1736	60	.8660
20	.3420	70	.9397
30	.5000	80	.9848
40	.6428	90	1.0000

Figure 2C.

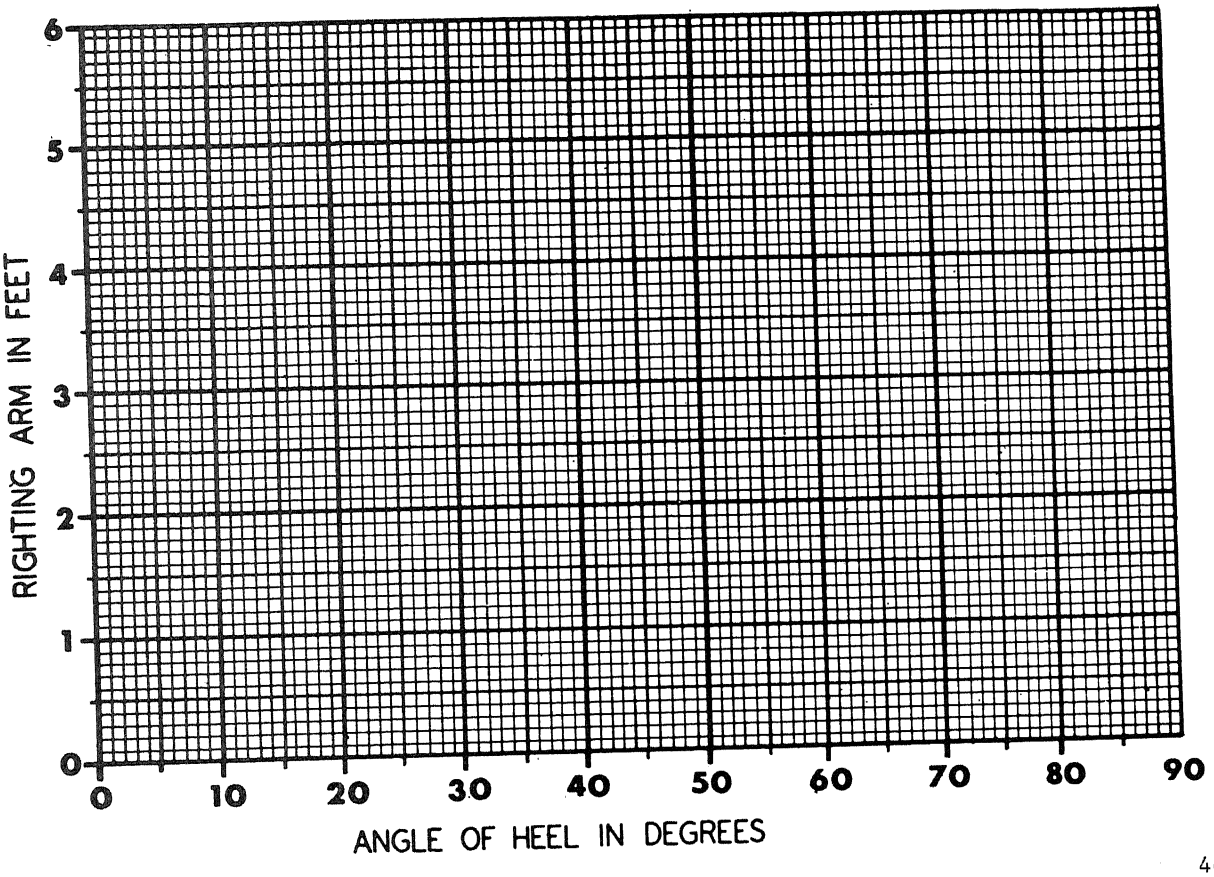


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Figure 2D.

● In items 2-28 through 2-31, assume that you are plotting the stability curve for the USS Middletown when it displaces 10,500 tons. To answer the items you will have to (1) read the ship's righting arm values from the cross curves of stability in figure 2C, (2) plot the values as points on an uncorrected stability curve using the graph paper in figure 2D, and (3) draw a corrected stability curve assuming an actual KG of 25 feet. Do not try to answer the items before you draw both the uncorrected and corrected stability curves.

2-28. What point on the uncorrected stability curve indicates the greatest stability?
1. 20° at 2.9 ft
2. 30° at 4.3 ft
3. 40° at 5.1 ft
4. 50° at 5.5 ft

2-29. The corrected stability curve indicates that the buoyant force tending to return the ship to even keel is greatest when the angle of heel is
1. 30°
2. 40°
3. 50°
4. 55°

2-30. Based on the corrected stability curve and a 50-degree heeling angle, the ship's righting moment is about 16,800 ft-tons. At which of the following angles of heel does the ship exert a larger righting moment?
1. 10°
2. 20°
3. 30°
4. 60°

2-31. The ship should begin to develop an upsetting moment when it heels at an angle of
1. 40°
2. 50°
3. 68°
4. 90°

Learning Objective: Recognize the purpose and conditions for conducting an inclining experiment and use given data to determine metacentric height. Textbook pages 42 through 44.

2-32. The inclining experiment conducted on a naval ship is the method for exact determination of the
1. ship's displacement in sea water
2. position of the ship's center of gravity
3. position of the ship's center of buoyancy
4. position of the ship's metacenter

2-33. A small vessel is floating at even keel in sea water. A 2-degree list was produced by moving a 10-ton weight 13.96 feet from the centerline. Compute the vessel's metacentric height if displacement is 3,990 tons exclusive of the 10-ton weight. Tan 2° = 0.0349.
1. 0.5 ft
2. 1.0 ft
3. 1.5 ft
4. 2.0 ft

2-34. What is the basic loading condition for conducting the inclining experiment?
1. Light ship condition
2. Minimum operating condition
3. Optimum battle condition
4. Full load condition

Learning Objective: Identify and calculate the effects of weight shifts and weight changes. Textbook pages 44 through 52.

2-35. A 60-by-21-foot box-shaped craft is floating level in sea water at a draft of 3 feet. A 13 1/2 ton weight is moved outward from the centerline of the craft shifting the center of gravity 0.5 foot. How far was the weight moved?
1. 4 ft
2. 6 ft
3. 8.2 ft
4. 10.5 ft

● Information for items 2-36 through 2-38: A certain ship has a displacement of 12,000 tons. Machinery weighing 800 tons is moved from topside to a compartment 12 feet directly below.

2-36. How are the ship's center of gravity and metacentric height affected by the weight movement?
1. G moves downward 0.8 ft and GM increases 0.8 ft.
2. G moves upward 0.8 ft and GM decreases 0.8 ft.
3. G moves downward 0.8 ft and GM decreases 0.8 ft.
4. G moves upward 0.8 ft and GM increases 0.8 ft.

2-37. Find the change in righting arm at a 30-degree angle of heel. (Sin 30° = 0.5000)
1. Minus 0.4 ft
2. Minus 0.2 ft
3. Plus 0.2 ft
4. Plus 0.4 ft

2-38. Why is it possible to derive a new righting arm curve from the old righting arm curve by correcting for change in righting arm only?
1. Because the center of gravity has not moved
2. Because GM has increased
3. Because GR is very small
4. Because displacement remains the same

2-39. Which distance in textbook figure 3-21 represents the residual maximum righting arm as shown in textbook figure 3-20?
1. AB
2. AC
3. EF
4. HI

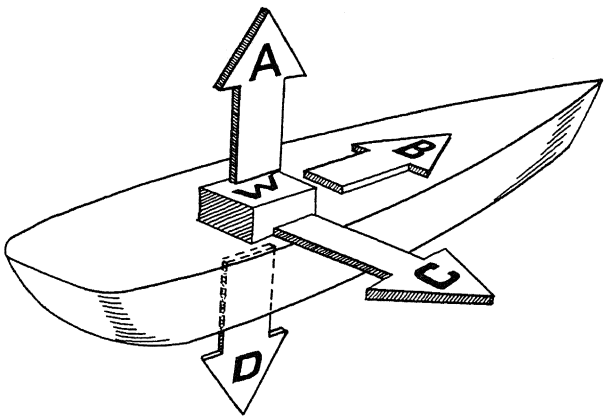

Figure 2E. 468

2-40. In what direction, if any, will the center of gravity move if weight W in figure 2E is moved in direction B?
1. A
2. B
3. C
4. None

2-41. Assume that a 172-ton weight is shifted athwartships a distance of 30 feet. If the ship has a displacement of 12,000 tons, find (a) the amount of shift of G and (b) the ship's approximate inclining moment at a 20-degree angle of heel. (Cos 20° = 0.9397)
1. (a) 1.1 ft; (b) 31,410 ft-tons
2. (a) 0.11 ft; (b) 3,140 ft-tons
3. (a) 4.3 ft; (b) 48,500 ft-tons
4. (a) 0.43 ft; (b) 4,850 ft-tons

2-42. In what direction must weight W in figure 2E be moved to produce an inclining moment?
1. A
2. B
3. C
4. D

2-43. As indicated in textbook figure 3-24, the loss of righting arm at a 37° angle is approximately
1. equal to the residual maximum righting arm
2. equal to twice the old righting arm at 37 degrees
3. two feet
4. three-fourths of a foot

2-44. Dividing added weight by the tons-per-inch immersion for the old mean draft is a step in determining the new displacement of a ship when weight is added. When may this step be used?
1. When the change in draft is one foot or less
2. When the change in draft exceeds one foot
3. When the weight added is one ton or less
4. Under all conditions

● Information for items 2-45 through 2-48. Assume that two 50-ton vehicles are loaded aboard a ship with a displacement of 11,900 tons and a KG of 22 feet. The vehicles are located so that the center of gravity is not shifted. Later the vehicles are moved upward to another deck; and their center of gravity is 46 feet above the keel. Assume that the curves of form (textbook figure 3-25) and cross curves of stability (textbook figure 3-14) apply.

2-45. Determine the vertical shift of G.
1. Plus 0.20 ft
2. Minus 0.20 ft
3. Plus 0.24 ft
4. Minus 0.24 ft

2-46. Compute the new height of G above keel and the new metacentric height, respectively.
1. 0.20 ft; 2.20 ft
2. 2.20 ft; 3.7 ft
3. 12.00 ft; 4.2 ft
4. 22.20 ft; 5.6 ft

(continued on next page)

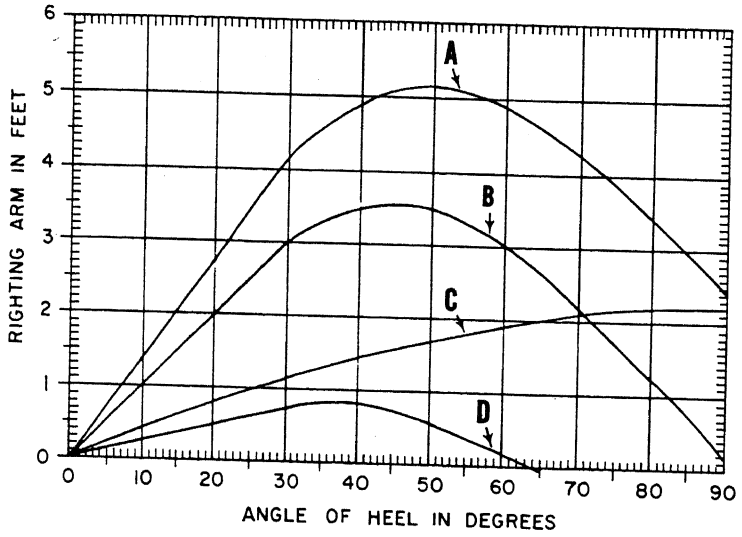

Figure 2F.

2-47. Which curves in figure 2F most nearly represent the uncorrected and corrected stability curves respectively?
1. A and B
2. A and C
3. B and C
4. B and D

2-48. Assume that the load is moved 18 feet to starboard from the centerline causing a 10° list. Determine the loss in righting arm and the location of the final GZ relative to curve A, B, C, or D in figure 2F. (Cosine 10° = 0.9848).
1. 0.15 ft; slightly below curve B
2. 1.50 ft; slightly below curve D
3. 8.64 ft; slightly below curve B
4. 0.86 ft; slightly below curve D

Learning Objective: Identify and calculate the effects of loose water in a ship. Textbook pages 52 through 60.

2-49. Under which of the following conditions should you refer to water in a tank of a ship as loose water?
1. The water has a free surface.
2. The water has entered the tank as a result of damage.
3. The tank is completely full.
4. The surface of the water inclines when the ship heels.

2-50. What is the free surface effect of a 30- by 30-foot portside compartment half filled with water on a ship with a 950,000 cubic foot displacement?
1. $\frac{27,000}{1583}$ x sin θ
2. $\frac{30^3 \text{ x } 60}{1583}$ x 950,000
3. $\frac{67,500}{950,000}$ x sin θ
4. $\frac{30^4}{27,000}$ x 950,000

2-51. A 35-foot square compartment in a 35,000 ton ship is half filled with sea water. The loss in metacentric height due to free surface effect is about
1. 0.01 ft
2. 0.05 ft
3. 0.1 ft
4. 0.2 ft

2-52. Suppose that in a ship displacing 5,000 tons, a compartment is partially filled with sea water. Compute the approximate rise in G due to free surface effect if the length of the compartment is 14 feet and its breadth is 30 feet.
1. 0.025 ft
2. 0.05 ft
3. 0.18 ft
4. 0.63 ft

● Information for items 2-53 through 2-59: One cubic foot of salt water = 1/35 of a ton.

2-53. Assume that the compartment of item 2-52 is divided into two 15 by 14 foot compartments and that both are partially flooded. The total rise in G due to the free surface effect of both compartments is about
1. 0.025 ft
2. 0.045 ft
3. 0.1 ft
4. 0.2 ft

2-54. Loose water shifting in the tanks of a ship causes a loss in GM. At small heeling angles the loss is not influenced by the
1. depth of the water
2. athwartship breadth of the free surface
3. fore-and-aft length of the free surface
4. displacement of the ship

2-55. What advantage do longitudinal bulkheads provide in compartments containing loose water?
1. They reduce free surface effect.
2. They add low weight.
3. They eliminate pocketing effect.
4. They prevent off-center flooding.

2-56. How is loss of GZ affected by pocketing and why?
1. It is increased because of increased breadth of the free surface area.
2. It is increased because of decreased breadth of the free surface area.
3. It is decreased because of increased breadth of the free surface area.
4. It is decreased because of decreased breadth of the surface area.

2-57. Assume that the fore-and-aft bulkhead between two adjacent compartments has a large hole so that loose water is free to flow from one compartment to the other. The free surface effect is similar to that of
1. two compartments of the same size with hole-free bulkheads
2. two compartments of the same size completely filled with water
3. one compartment of the same size as the larger of the two compartments in question
4. one compartment of the same size as the two combined

2-58. Assume that an off-center compartment has been ruptured by a torpedo and the compartment is in free communication with the sea. What factors must you consider when calculating the reduction of the righting arm?
1. The free communication effect and the free surface effect
2. The free surface effect and the added weight effect
3. The added weight effect and the free communication effect
4. The added weight effect, the free communication effect, and the free surface effect

2-59. A ship displacing 5,000 tons is hit by a torpedo slightly below the waterline causing severe flooding of a compartment measuring 24 feet fore-and-aft and 14 feet athwartship. What is the approximate reduction or increase of righting arm, if 40 tons of water are taken on at a 30° angle of heel, assuming the value of y is 25 feet? (Sin 30° = 0.5000)
1. 1.2 ft
2. 0.6 ft
3. 0.2 ft
4. 0.06 ft

2-60. Which of the following conditions is most likely to reduce reserve buoyancy and stability?
1. Ballasting fuel tanks
2. Heavy topside icing
3. Loss of deck cargo
4. Shifting of cargo to lower holds

2-61. The addition of weight above a ship's center of gravity causes a loss in stability because
1. reserve buoyancy is increased
2. righting arms are increased due to loss of freeboard
3. righting arms are decreased due to rise in G
4. righting moments are decreased due to increased displacement

2-62. Carelessness in the maintenance of watertight boundaries may lead to reduced stability due to reduced
1. freeboard
2. righting moments because of increased displacement
3. righting arms because G is lowered
4. reserve buoyancy

2-63. Solid flooding is most likely to occur in vented compartments which are located
1. below the waterline
2. at the waterline
3. above the waterline forward
4. above the waterline aft

2-64. Changes in a ship's stability resulting from solid flooding are the same as changes caused by
1. added low weight
2. free communication to the sea
3. free surface effect of loose water
4. decreased draft

2-65. Under what circumstances does flooding increase the stability of a ship?
1. When free communication occurs
2. When solid flooding occurs and the added weight is above the ship's center of gravity
3. When solid flooding occurs and the added weight is below the ship's center of gravity
4. When free surface occurs high in the ship

2-66. In an intact shell, loose water influences stability because of its
1. weight only
2. free surface effect only
3. weight and free surface effect
4. free surface and free communication effects

Learning Objective: Identify and calculate changes in the effects of longitudinal stability and trim. Textbook pages 56 through 60.

2-67. Which of the following conditions exists when a ship is trimmed by the stern?
1. The distance between the keel and the waterline is greater at the stern than at the bow.
2. The distance from the main deck to the waterline is greater at the stern than at the bow.
3. The distance between the keel and the waterline is greater at the bow than at the stern.
4. The distance from the main deck to the waterline is greater amidships than at the bow.

● When answering items 2-68 through 2-70, assume that a ship with a forward draft of 15 feet 8 inches, and an aft draft of 16 feet 4 inches undergoes a trimming moment of 12,000 ft-tons when part of her load is moved from 120 feet aft of the center of flotation (mid-perpendicular point) to 120 feet forward of the center of flotation. Consider the curves of form in textbook figure 3-25 correct for this ship and use the curves to determine MTI and other necessary information.

2-68. What is the weight of the load moved and the mean draft?
1. 45 tons; 1.2 ft
2. 45 tons; 14 ft
3. 50 tons; 16 ft
4. 50 tons; 18 ft

2-69. Determine the change in trim and the new drafts, respectively.
1. 10 in.; fwd draft 16 ft 1 in. and aft draft 15 ft 11 in.
2. 9 in.; fwd draft 16 ft 0.5 in. and aft draft 15 ft 11.5 in.
3. 8 in.; fwd draft 16 ft and aft draft 16 ft
4. 7 in.; fwd draft 15 ft 11.5 in. and aft draft 16 ft 0.5 in.

2-70. Assume that a 60-ton weight is located directly beneath the center of flotation. What is the approximate mean draft after the weight is removed?
1. 15 ft
2. 15 ft 11 in.
3. 16 ft
4. 16 ft 1 in.

2-71. How does trim by the bow affect a ship's metracentric radius and transverse metra center?
1. Both will decrease.
2. Both will increase.
3. BM will decrease and KM will increase.
4. BM will increase and KM will decrease.

Assignment 3

Preventive and Corrective Damage Control

Textbook Assignment: Pages 61 - 80

Learning Objective: Point out basic principles of the shipboard damage control organization. Textbook pages 61 through 63.

3-1. The engineering casualty control phase of the shipboard damage and casualty control function is concerned with
1. repairing structural damage
2. minimizing the effects of battle casualties to machinery
3. maintaining watertight integrity
4. preserving transverse and longitudinal stability

3-2. The responsibility for establishing and maintaining an effective damage control organization aboard ship rests directly with the
1. commanding officer
2. engineer officer
3. stability officer
4. damage control assistant

3-3. What are the constituents of a standard shipboard damage control organization?
1. Damage control central and unit patrols
2. Damage control central and repair parties
3. Damage control central, repair parties, and unit patrols
4. Damage control central, repair stations, and unit patrols

3-4. Damage control operations aboard ship are directed by the
1. executive officer
2. engineer officer
3. stability officer
4. damage control assistant

3-5. Who assists the damage control assistant (DCA) in damage control central?
1. Stability officer
2. Casualty board operator
3. Damage analyst
4. Each of the above

3-6. Damage control stations 7 and 8 are included in which of the following ship types?
1. Aircraft carrier
2. Destroyer
3. Submarine
4. Cruiser

3-7. Which of the following statements pertaining to damage control organizations is true?
1. Each repair party has a commissioned officer in charge.
2. A noncommissioned officer who is qualified in damage control may be placed in charge of a repair party.
3. The assistant officer in charge of a repair party is usually a junior commissioned officer.
4. The number of men available is the only factor that determines the number of men assigned to a repair station.

3-8. Operating instructions posted at a repair station should include instructions for
1. assigning personnel
2. handling the machinery within its area of responsibility
3. passing control from one station to another
4. all the above

Learning Objective: Specify some of the measures carried out in the performance of shipboard damage control. Textbook pages 63 through 74.

3-9. Aboard naval ships, material conditions of readiness represent
1. repair station assignments for maximum battle effectiveness
2. positions of attacking ships or planes
3. degrees of tightness and protection against damage
4. frequencies with which entries are made in a closure log

3-10. Which fittings are closed when general quarters stations are manned?
1. Z and (Z)
2. Z, (Z), and (Y)
3. X, Y, Z, and (Z)
4. X, Y, Z, (X), (Y), and (Z)

3-11. During general quarters, a hatch in the engineering spaces with a closure fitting marked Z will be opened only by permission of the
1. DCA
2. damage analyst
3. commanding officer through the DCA or OOD
4. engineer officer

3-12. During which material conditions of readiness are Y and (Y) fittings secured?
1. X-RAY and YOKE
2. X-RAY, YOKE, and ZEBRA
3. YOKE and ZEBRA
4. X-RAY and ZEBRA

3-13. During which material condition of readiness, if any, are W fittings normally secured?
1. X-RAY
2. YOKE
3. ZEBRA
4. None

3-14. Circle William, (W), fittings of a ship are closed when
1. condition ZEBRA is set
2. nuclear attack is imminent
3. the ship enters or leaves a port
4. the ship is at sea during time of war

3-15. Which of the following pieces of information should be included on the report to the DCA by the repair party investigating a flooding condition?
1. Overall extent and nature of flooding
2. Nature of damage to electrical system
3. Area in which damage is suspected
4. All the above information

3-16. What, if any, of the information received by damage control central does the DCA forward to the bridge?
1. All information reported by the repair parties
2. Only the information for which the CO expressed a desire
3. Information about damage which the DCA has verified
4. None

3-17. Which of the following corrective measures belongs in the overall ship-survival category?
1. Rigging casualty power
2. Establishing flooding boundaries
3. Extinguishing fires
4. Improving trim

3-18. A damaged ship's metacentric height is usually improved when
1. low weights are jettisoned
2. free communication with the sea is introduced
3. free surface is suppressed
4. solid weights are moved to higher levels

3-19. Which of the following is a corrective action for a ship that is listing dangerously to port as a result of flooding?
1. Flooding an area on the starboard side directly opposite the flooded port area
2. Jettisoning topside weights from the port side
3. Pumping liquids from port to starboard
4. Each of the above actions

3-20. Restoring freeboard and reserve buoyancy on a stabilized ship requires the removal of weight which is generally accomplished by
1. unballasting fuel tanks
2. pumping out flooded compartments
3. jettisoning topside weights
4. jettisoning centerline weights

3-21. What is usually the only effective way to correct severe trim in a damaged ship?
1. Pumping out flooded water from the low end
2. Pumping liquids fore-and-aft
3. Jettisoning topside weights from the low end
4. Shifting solid weights fore-and-aft

3-22. Immediate local corrective measures by a repair party at the scene of damage should be carried out quickly without instructions from higher authority.

3-23. The use of what substance is preferred for extinguishing a fire that occurs in electrical equipment?
1. Foam
2. Water
3. Steam
4. Carbon dioxide

3-24. Which factor makes the fighting of class D fires especially hazardous to personnel?
1. Presence of toxic gases and intense heat
2. Possibility of hydrogen explosions
3. Splattering of molten metal
4. Each of the above

3-25. One of the first duties of the scene leader in a firefighting party is to
1. decide which equipment to use
2. man the oxygen breathing apparatus
3. sound the fire call
4. draw his equipment from the prescribed place

3-26. The number of hosemen assigned to a fire-fighting party is determined by
1. the number of men available
2. the size of the firehose
3. both the above factors
4. the DCA

3-27. Which members of a large fire-fighting party man the fire axes, crowbars, and bolt cutters?
1. Plugmen
2. Hosemen
3. Access men
4. Nozzlemen

3-28. Secondary fire boundaries are usually established by the
1. fire scene leader
2. closure detail
3. OBA men
4. access men

3-29. When oxygen breathing apparatus is needed to investigate a fire on a cruiser, the men wearing the apparatus belong to the
1. attacking group
2. supporting group
3. standby group
4. closure detail

3-30. Quick action by your fire party has confined a class A fire to a single small stores compartment, but has not yet brought it under control. A narrow passageway to the single entrance permits only two men to reach the fire scene. Other men in your party should be sent to
1. cut through a bulkhead and set up additional hoses
2. enter adjoining compartments and cool down the bulkheads
3. secure equipment behind the fire scene
4. carry reports back to the JZ talker

3-31. From which compartments should you remove water first during dewatering?
1. Highest compartments that contain loose water
2. Highest compartments that are solidly flooded
3. Lowest compartments that contain loose water
4. Lowest compartments that are solidly flooded

3-32. Before starting dewatering operations you should consult the ship's Damage Control Book to determine
1. what type of equipment to use
2. the most effective dewatering procedure to follow
3. the approximate number of men and man hours required
4. all the above

In items 3-33 through 3-35, select the flooding effect from column B that is indicated by the compartment color (on flooding effect diagram) in column A.

A. Colors	B. Effects
3-33. Pink	1. Solid flooding improves stability and partial flooding decreases stability.
3-34. Green	2. Flooding has no effect on stability.
3-35. Yellow	3. Flooding decreases stability.
	4. Flooding improves stability.

3-36. A compartment on a flooding effect diagram is left uncolored if flooding of the compartment
1. has no very definite effect on the ship's stability
2. results in a decrease in stability
3. improves stability, even though free surface exists
4. improves stability when the compartment is solidly flooded but impairs stability when a free surface exists

3-37. For a given suction lift the discharge volume of a standard portable submersible pump is greatest at the lowest discharge head.

3-38. The portable submersible pump used in the Navy consists of
1. a centrifugal pump driven by a constant speed electric motor
2. a centrifugal pump driven by a variable speed electric motor
3. an axial piston type pump driven by a constant speed electric motor
4. an axial piston type pump driven by a variable speed electric motor

3-39. When it is necessary to pump against a high discharge head, delivery of the portable submersible pump can be increased by
1. increasing the length of the discharge hose
2. increasing the speed of the motor
3. kinking the discharge hose
4. operating two pumps in tandem

3-40. As the result of an explosion your ship suffers a hole, 21.5 square inches in area, below the waterline near midship. The affected compartment is completely flooded, but with the exception of the large hole, and several small holes in the inboard bulkhead, it is watertight. What is a logical first action to take?
1. Dewater the compartment.
2. Completely plug the large hole.
3. Partially plug the large hole.
4. Plug the small holes.

3-41. Holes in the hull of a ship at, or just above, the waterline should be plugged as soon as possible, chiefly because these holes may
1. cause the buckling of deck plating
2. rupture bulkheads below the waterline
3. admit water at points that are above the center of gravity of the ship
4. increase in size from the force of the waves

3-42. Which of the following is a block which is triangular on the sides and rectangular on the butt end?
1. Strongback
2. Wedge
3. Shole
4. Shore

3-43. A flat block which can be placed under the end of a shore to distribute weight or pressure is known as a
1. wedge
2. shole
3. strongback
4. shim

3-44. One of the most important damage control devices aboard ship is the casualty power system which is designed to provide power to operate
1. vital machinery in emergencies only
2. all shipboard machinery at near-normal capacity
3. equipment used to effect temporary repairs
4. lighting and pumping equipment

Learning Objective: Point out fundamentals of detecting nuclear radiation, biological agents, and chemical agents. Textbook pages 75 through 77.

3-45. Although visual means are not reliable in detecting NBC contaminants, colors serve to identify
1. most radiological agents
2. some chemical agents
3. some biological agents
4. most disease-causing chemical and biological agents

3-46. The term "radiac" refers to
1. radioactivity defense, identification, and calibration
2. radiation, detection, indication, and computation
3. radiological activity detection, interception, and computation
4. radioactivity decontamination, identification, and computation

3-47. The device which measures the total radiation dosage received by an individual exposed to nuclear radiation is called a
1. dose-rate meter
2. Geiger tube
3. survey meter
4. dosimeter

3-48. Roentgens per hour is a unit of measure for the
1. intensity of gamma or x-ray radiation
2. number of beta particles present
3. number of alpha particles present
4. amount of nuclear radiation accumulated

3-49. The Geiger-Mueller type of intensity meter is capable of measuring
1. gamma radiation only
2. both gamma and beta radiation directly
3. gamma radiation directly, and a combination of both gamma and beta radiation
4. gamma, beta, and alpha radiation directly and independently

3-50. Most pocket dosimeters are designed to measure accumulated doses of
1. alpha particles
2. beta particles
3. gamma radiation
4. all the above

3-51. The DT-60/PD radiac is used to measure
1. total radiation doses
2. radiation intensity
3. accumulated gamma doses
4. accumulated beta doses

3-52. How is the DT-60/PD radiac read?
1. By reading directly a graduated scale on the instrument
2. By converting a scale reading into roentgens using a prepared chart
3. By using a special instrument called a computer-indicator
4. By using special instruments available only in radiologic laboratories

3-53. What is a film badge?
1. Nonself-reading dosimeter designed to measure gamma and beta radiation
2. Nonself-reading dosimeter designed to measure gamma radiation only
3. Self-reading dosimeter designed to measure gamma and beta radiation
4. Self-reading dosimeter designed to measure gamma radiation only

3-54. What is a significant disadvantage in the biological detection method of BW agents?
1. Positive identification is impossible.
2. The procedure is very slow permitting personnel to become affected before the results are known.
3. Medical experts are required to perform every part of the process.
4. The results are useless unless the process is accomplished very quickly.

Learning Objective: Identify the basic principles of NBC defense. Textbook pages 74 through 80.

3-55. The responsibility for keeping a ship's NBC Defense Bill up to date and ready for immediate use rests with the
1. commanding officer
2. executive officer
3. engineer officer
4. DCA

3-56. In the preparation for an anticipated NBC attack, the topside areas of a ship should be
1. cleared of all emergency equipment
2. covered with a protective material
3. treated with decontaminants
4. washed down

3-57. What protection against NBC contaminants is provided by permeable protective clothing?
1. It prevents penetration of biological and chemical agents.
2. It absorbs radio active vapors.
3. It neutralizes blister and nerve agents vapors and fine spray.
4. It neutralizes all NBC contaminants except gamma rays.

3-58. Although the protective mask provides excellent protection to the wearer, it is ineffective against
1. liquid mustard
2. chemically contaminated dust particles
3. toxic gas vapors
4. carbon monoxide

3-59. Radiological monitoring should provide damage control central with
1. the location of the contamination
2. the type of contamination
3. the intensity of the radiation
4. all the above information

3-60. What radiological survey party monitors the food and water supplies aboard ship?
1. Detailed personnel safety survey party
2. Detailed ship survey party
3. Gross personnel safety survey party
4. Gross ship survey party

3-61. Aboardship personnel dosage records are maintained by
1. the medical department
2. the engineering department
3. each division officer
4. damage control central

3-62. To complete a useful radiological survey, a monitor must take each of the following actions except
1. recording accurately the distance between the instrument and the source
2. holding the instrument as close to the source as possible
3. indicating on his report the location of the object in relation to a fixed point
4. noting the exact time of the measurement

3-63. Standard contamination markers having red lettering on a yellow background signify contamination by
1. nuclear radiation
2. biological agents
3. chemical agents
4. biological and chemical agents

3-64. In the interest of personnel protection, NBC contaminated areas are usually decontaminated by
1. destroying the contamination
2. destroying, removing, or neutralizing the contamination
3. destroying radiological and chemical contamination, and removing biological contamination
4. destroying chemical contamination, neutralizing radiological contamination, and removing or shielding biological contamination

3-65. At sea radiological decontamination is a process by which the hazards of radioactivity are dealt with by
1. neutralizing the contamination
2. dropping the contamination into the sea
3. destroying the contamination
4. shielding the contamination

3-66. What is the purpose of gross radiological decontamination?
1. Reducing radiation intensity to a safe level as rapidly as possible
2. Neutralizing radiation contamination as completely as possible
3. Removing radiation contamination as rapidly as possible
4. Destroying radiation contamination, as completely as possible

3-67. Although flushing with water is the most practicable gross radiological decontamination method for an area, when is steam recommended?
1. Greasy or oily films must be removed from the area.
2. Speed is the major consideration.
3. The area includes weather decks.
4. The area must be occupied by personnel.

3-68. When used as the sole method of decontamination, which of the following is a practicable method for detailed radiological decontamination?
1. Flushing with fresh water
2. Firehosing with sea water
3. Scrubbing with detergents
4. Sealing and aging

3-69. Whether a certain method of biological decontamination is to be used or not depends on its availability, nature of the biological agent (when known), and nature of the area or equipment to be decontaminated.

3-70. Decontamination by chemical action involves a chemical reaction that results in neutralization of chemical agents by
1. chlorination
2. oxidation
3. hydrolysis
4. any of the above

3-71. When decontamination by burning is used, the fire must be very hot to prevent volatilization of the checmical agents.

● Before going on to the next assignment make the following change: In the textbook, page 89, left column, fourth paragraph, fourth sentence, change "right" to "left" so as to read "Multiple screw ships have left hand propellers to port."

Assignment 4

Fundamentals of Ship Propulsion and Steering

Textbook Assignment: Pages 85 - 111

Learning Objective: Identify causes of resistance encountered by a moving ship. Textbook page 85.

In items 4-1 through 4-3, select from column B the type of resistance that is due to the cause in column A.

	A. Causes	B. Types of resistance
4-1.	Fluid shear between adjacent layers of water	1. Air resistance
4-2.	Generation and propagation of wave trains by a moving ship	2. Eddy resistance
4-3.	Flow lines not closing in behind a moving ship and creating a low pressure area in the water behind the stern	3. Wave-making resistance
		4. Skin resistance

Learning Objective: Identify unit functions that develop or transmit propulsive power or control ship's movement and definitions of terms and nomenclature used in describing propulsion and steering equipment. Textbook pages 86 through 88, 91, 99, and 111.

In items 4-4 through 4-7, select from column B the function of the unit in column A.

	A. Units	B. Functions
4-4.	Prime mover	1. Absorbs axial thrust transmitted from propelling device
4-5.	Propulsion shaft	2. Controls direction of movement of a ship
4-6.	Rudder	3. Transmits mechanical energy to propelling device
4-7.	Thrust bearing	4. Provides mechanical energy to drive propelling device

In items 4-8 through 4-10, select from column B the location of the measurements for the terms in column A.

	A. Terms	B. Definitions
4-8.	Brake horsepower	1. Power required to tow a ship
4-9.	Indicated horsepower	2. Power measured at the crankshaft coupling of internal combustion engines
4-10.	Effective horsepower	3. Power transmitted through the shaft of a ship to the propeller
		4. Power measured in the cylinders of steam reciprocating engines

4-11. The propulsive efficiency (or coefficient) of a ship is defined as the relationship between
1. brake horsepower and shaft horsepower
2. effective horsepower and shaft horsepower
3. indicated horsepower and shaft horsepower
4. effective horsepower and indicated horsepower

4-12. Define slip as it pertains to a ship's propeller.
1. Difference between RPM and theoretical advance
2. Difference between actual and theoretical advance in one revolution of the propeller
3. Free movement of the shaft in the propeller
4. Difference between the linear velocities of the edges of the propeller blades

4-13. The part of the propeller blade that first cuts the water when a ship is going ahead is called the
1. tip
2. root
3. trailing edge
4. leading edge

4-14. The propeller blade of textbook figure 5-3 part B, is raked aft.

In items 4-15 through 4-17, select from column B the definition of the term in column A.

A. Terms	B. Definitions
4-15. Wake	1. Increase in resistance resulting from the suction created by propellers as they draw water from under the stern of a ship
4-16. Thrust deduction	2. Formation of a vacuum around a ship's propeller that is rotating faster than its critical speed
4-17. Cavitation	3. Velocity imparted to water by rotating blades of a ship's propeller
	4. Forward movement of water caused by friction between the water and a ship's hull

4-18. What are fairwaters?
1. Sheets of synthetic rubber secured to the wet shafting of twin-screw destroyers
2. Circular shields secured to the stern tube bearings, strut bearings, and outboard flange couplings to reduce underwater resistance
3. Intermediate or dropout sections of the wet shafting on carriers and cruisers
4. Composition sleeves shrunk on the part of the outboard shaft that turns in the stern tube bearing

4-19. What is the yoke or quadrant of a ship's rudder assembly?
1. Part that maintains the ship's headings
2. Part that houses the rudder stock
3. Part that transmits steering motion to the rudder stock and rudder
4. Part inside a hollow-type rudder that supports the rudder stock

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Learning Objective: Recognize principles that are applicable to the mechanics of ship propulsion and steering. Textbook pages 87 through 93, 99, 100, and 111.

4-20. In cases where ship models are towed in basins to determine power requirements, which data are collected for use in the basic formula for effective horsepower?
1. Tow rope resistance and propeller speed
2. Hull resistance and propeller speed
3. Tow rope resistance and ship's speed
4. Skin resistance and torque required to turn the propeller

4-21. Power requirements to propel a ship under steady running conditions can be estimated by using the guideline that says that the power is approximately proportional to the cube of propeller speed.

4-22. The pitch of the propeller in a certain vessel is 12' 6" and the average speed for all shafts for a 24-hour run is 200 rpm; the distance covered is 400 NT miles. What is the slip ratio? (1 NT mile = 6080 FT)
1. 28.2%
2. 30.3%
3. 32.4%
4. 34.5%

4-23. Deleted.

4-24. When a ship is moving forward, the after side of the propeller blade applies pressure on the water.

4-25. The velocity imparted to the water by a rotating propeller depends on
1. the angular velocity of the blade
2. the blade angle
3. both of the above
4. the direction of rotation

4-26. Why does the pitch angle of a real propeller blade vary along the length of the blade from root to tip?
1. To enable each area of the blade to produce equal thrust
2. To vary the thrust at each point along the length of the blade
3. To keep slip ratio at a minimum
4. To keep propeller shaft torque at a minimum without decreasing thrust

4-27. Unless the total thrust on a two-bladed propeller is maximum, thrust can be increased by
1. reducing the pitch
2. increasing the radius of the propeller
3. increasing the blade area of the propeller
4. doing both 2 and 3 above

4-28. When the pitch of the controllable pitch propeller blades is changed by hydraulic means, pressurized oil is used to reposition a piston which is connected to the blades.

4-29. Which of the following is a result of cavitation?
1. Erosion of propeller blades
2. Metal fatigue of propeller blades
3. High level of underwater noise
4. Each of the above

4-30. The noise from a "singing" propeller is usually caused by
1. cavitation
2. racing
3. improperly prepared trailing edges of blades
4. nicked leading edges of blades

4-31. Assume that a 5 to 1 single reduction gear is used on a small boat to enable the prime mover and propeller to operate at their most efficient speeds. How fast does the drive shaft of the prime mover turn when the propeller speed is 150 rpm?
1. 30 rpm
2. 150 rpm
3. 750 rpm
4. 1,500 rpm

4-32. Refer to figure 5-16 of the textbook. The advantages of the double helical gear over the single helical gear include
1. absence of end thrust
2. smoother action
3. less tooth shock
4. all the above

4-33. A ship's propulsion plant is equipped with a double reduction gear arrangement designed to provide a 15 to 1 speed reduction. What respective gear ratios between the high speed pinion and the first reduction gear and the low speed pinion and the second reduction gear will accomplish the speed reduction?
1. 10 to 1 and 5 to 1
2. 5 to 1 and 1 to 20
3. 3 to 1 and 5 to 1
4. 3 to 1 and 12 to 2

4-34. Why is the reduction gear of the Navy's high powered combatant ships of the locked train type rather than the nested type?
1. Locked train gearing is more compact than nested.
2. Locked train gearing uses fewer quill shafts than nested.
3. Locked train gearing uses fewer bearings than nested.
4. Locked train gearing uses fewer flexible couplings than nested.

4-35. Where should a ship's rudder be located to be most effective?
1. Forward of, and as close as possible to, the propeller
2. Forward of, and as far as possible from, the propeller
3. Aft of, and as close as possible to, the propeller
4. Aft of, and as far as possible from, the propeller

Learning Objective: Identify properties of bearing materials, principles of bearing classification, and characteristics of bearings. Textbook pages 93 through 96.

4-36. An alloy used as bearing metal should be capable of
1. resisting fatigue to prevent eroding and flaking
2. retaining an effective oil film
3. conducting heat to prevent hot spots
4. doing all the above

4-37. A metal bushing that supports a shaft rotating inside the bushing is classified as a
1. sliding surface bearing
2. rolling contact bearing
3. spot contact journal bearing
4. line contact bearing

4-38. What is an advantage of split friction bearings over full friction bearings?
1. Split bearings can be made adjustable to compensate for wear.
2. Split bearings provide more contact and therefore more bearing surface.
3. Split bearings are self-aligning.
4. Split bearings provide better resistance to wear.

4-39. Some bearings are classified as antifriction bearings because they are designed to
1. eliminate all friction between moving parts
2. require less energy by substituting rolling friction for sliding friction
3. contact fewer moving parts than do friction bearings
4. provide a rolling rather than a sliding surface

4-40. What is the basic difference between a roller bearing and a ball bearing?
1. A roller bearing carries radial loads only; a ball bearing carries both radial and thrust loads.
2. A roller bearing carries radial and thrust loads; a ball bearing carries thrust loads only.
3. A ball bearing carries its load on two diametrically opposed points of contact; a roller bearing carries its load on two lines of contact.
4. A ball bearing carries its load on two directly opposed lines of contact; a roller bearing carries its load on two points.

4-41. Angular-contact bearings support both axial and radial loads.

4-42. For which radial bearings is there no way to compensate for worn surfaces?
1. Integral type and insert split bushing type
2. Integral type and insert solid bushing type
3. Pivoted-shoe type and insert split bushing type
4. Insert solid bushing and split bushing types

4-43. The function of which bearing is not limited to the carrying of axial loads only?
1. Multidisk thrust bearing
2. Pivoted-shoe thrust bearing
3. Plain pivot thrust bearing
4. Radial thrust bearing

Learning Objective: Recognize construction features of reduction gear bearings, line shaft bearings, stern tubes, strut bearings, and propulsion shafting. Textbook pages 96 through 99.

4-44. Which statement pertaining to babbitt-lined, split-type reduction gear bearings is true?
1. They are always mounted with the split in a horizontal plane.
2. They are secured in their housings so pressure points will occur at the joint faces.
3. They are split into four equal-sized segments.
4. They are rigidly mounted and dowelled in their housings.

4-45. All the following are construction features of spring bearings except
1. spherical-seated shells for self-alignment
2. grooves for distributing oil within the bearings
3. babbitt faces for minimizing wear and friction
4. packing glands for sealing spaces between the shaft and bearing liners

4-46. The same forced-feed system that lubricates reduction gear bearings is used to lubricate, cool, and flush stern tube stuffing boxes and glands.

4-47. Bushings in strut bearings are split radially into four segments that are welded to the strut.

4-48. Deleted.

4-49. The propulsion shafting of multiple-screw ships consists of the
1. line shaft, shaft couplings, shaft bearings, and the propeller shaft
2. thrust shaft, line shaft, stern tube shaft, and the tail shaft
3. line shaft, fairwater sleeve, strut, and the propeller shaft
4. thrust shaft, line shaft, bearings and couplings, and the strut

4-50. The wet shafting on multiple-screw ships is made up of the
1. tail and bull gear shafts
2. tail and stern tube shafts
3. tail shaft, dropout section, and a stern tube section
4. line shaft and a stern tube section

4-51. The portion of the propulsion shaft that turns in the stern tube bearing of a single-screw ship is normally protected against corrosion by a
1. heavy lubricant
2. metal sleeve
3. composition sleeve
4. synthetic sheet rubber covering

Learning Objective: Recognize operating principles of the main thrust bearing. Textbook page 96.

4-52. What is the principle of operation of the Kingsbury type of main thrust bearing?
1. A flat film of oil is more readily formed and maintained than a wedge-shaped film.
2. A wedge-shaped film of oil is more readily formed and maintained than a flat film.
3. A flat film of oil can carry heavier loads than a wedge-shaped film.
4. A wedge-shaped film of oil can carry unlimited loads.

4-53. The purpose of a ship's main thrust bearing is to absorb
1. ahead axial thrust transmitted through the shaft from the propeller
2. astern axial thrust transmitted through the shaft from the propeller
3. either ahead or astern axial thrust transmitted through the shaft from the propeller
4. radial and axial thrust transmitted through the shaft from the propeller

● When answering items 4-54 and 4-55 refer to textbook figure 5-11.

4-54. The thrust load on the bearing is equalized among the pivoted shoes by the
1. base ring
2. collar
3. leveling plates
4. oil wedge

4-55. The thrust on the leveling plates is transmitted to the ship's structure by the
1. collar
2. oil wedge
3. base ring
4. pivoted shoes

Learning Objective: Identify probable causes or sources of trouble in reduction gears, shafting, and bearings. Textbook pages 104 through 107.

4-56. A likely result of delivering too little or too much oil to a bearing is
1. an overheated bearing
2. an underheated bearing
3. a sharp rise in oil pressure followed by a drop in pressure
4. a drop in oil pressure followed by a sharp rise in pressure

4-57. What is the probable cause of rumbling and thumping noises in the propulsion machinery of a steam-turbine driven ship that is operating in shallow water?
1. Bowed rotor
2. Fouled propeller
3. High speed
4. Propeller vibration

4-58. The probable cause of a gradual increase in vibration in reduction gears that have operated smoothly for a long time is
1. misaligned gears
2. an unbalanced turbine rotor
3. improperly meshing gear teeth
4. burned-out bearings

4-59. When vibration occurs within the main reduction gears, where should you look first for possible damage?
1. Propeller
2. Main reduction gears
3. Main reduction gear bearings
4. Wet shafting

4-60. When adequate lubrication is provided for reduction gears and excessive gear tooth wear occurs, the wear is usually due to improper tooth contact.

4-61. When reduction gears are properly aligned and properly operated, scoring of gear tooth surfaces is usually due to
1. inadequate lubrication
2. soft material in the gears
3. excessive loading
4. insufficient running-in period

Learning Objective: Recognize practices in the maintenance and operation of reduction gears, shafting, and bearings. Textbook pages 104 through 111.

4-62. Which of the following is a necessary condition for proper lubrication of reduction gears and bearings?
1. Maintaining the proper quality and quantity of lube oil in the main sump
2. Supplying the required amount of lube oil to the gears and bearings at the proper pressure
3. Keeping the lube oil clean and at the proper operating temperature
4. Each of the above

4-63. If the temperature of oil entering a bearing is 125° F, the maximum allowable temperature of the oil leaving the bearing is
1. 130° F
2. 145° F
3. 160° F
4. 175° F

● When answering items 4-64 through 4-66, assume that the main shaft of a turbine-driven ship must be stopped and locked for more than five minutes to prevent damage to propulsion machinery.

4-64. What is the quickest efficient way to lock the shaft after it is stopped?
1. Apply the brake, then engage the turning gear.
2. Engage the turning gear, then apply the brake.
3. Apply the brake, engage the turning gear, then open the ahead throttle.
4. Engage the turning gear, open the ahead throttle, then apply the brake.

4-65. Since locking the main shaft for more than 5 minutes may result in a bowed turbine rotor, what procedure is recommended for turning the shaft after it is unlocked and free to turn?
1. Reduce ship's speed to zero by closing the astern throttle gradually, then open the ahead throttle slightly.
2. Open and close the astern throttle quickly to start and stop the shaft, then open the ahead throttle gradually.
3. Close the astern throttle slowly and allow the shaft to be turned by the torque produced by the propeller as it passes through the water.
4. Open the astern throttle slowly to start the shaft, then close the throttle when the shaft can be turned by the torque produced by the propeller as it passes through the water.

4-66. Suppose that vibrations from the turning shaft indicate a bowed rotor. Which of the following techniques will assist in straightening the rotor?
1. Reducing ship's speed and maintaining it at the speed where little or no vibration is noticed
2. Warming the shaft by opening the ahead throttle slightly to allow steam to flow through the turbine
3. Warming the shaft by lowering the main condenser vacuum so more heat can be added to the turbines
4. Any of the above

4-67. Refer to figure 5-23 in the textbook and assume that the work done by a repair activity on the main reduction gears of the ship included an inspection of the gear casing as called for by maintenance requirement S-1. The entry in the Engineering Log concerning the inspection must show the names of
1. all personnel who worked on the gears
2. all Machinist's Mates who worked on the gears
3. the leading Machinist's Mate and the inspecting officer from the ship
4. the inspecting officers from the ship's engineering department and from the repair activity

4-68. Two sets of reading are needed to check the alignment of a ship's propulsion shafting. When should the readings be taken?
1. On two separate occasions while the ship is in drydock
2. One set of readings when the ship is in drydock; the other set when the ship is waterborne and without load
3. On two separate occasions when the ship is under normal waterborne load
4. One set of readings when the ship is in drydock; the other set when the ship is under a normal waterborne load

4-69. During shipyard overhauls, the alignment between pinions and turbines should be checked when an inspection of the main turbine couplings indicates
1. excessive wear of the coupling
2. excessive thrust shoe clearance
3. wear of the thrust collar
4. any of the above conditions

4-70. Besides those directed by proper authority, which of the following checks for main reduction gears should be made after full power trials are conducted?
1. Checking clearance of main thrust bearing
2. Examining condition of gear teeth
3. Examining gear tooth contact
4. All the above

4-71. A ship's propeller shafts should be locked when divers are over the side inspecting or working near the propellers.

In items 4-72 through 4-74, select from column B the event for which the safeguard in column A is taken by operators of propulsion equipment.

A. Safeguards	B. Events
4-72. Lock the main shaft.	1. Anchoring a ship where the tides or currents are strong
4-73. Disengage the jacking gear clutch before the brake is released.	2. Allowing a main shaft to turn or trail
4-74. Control windage temperature inside low pressure turbine casing.	3. Unlocking a main shaft

4-75. Which precautionary measure must be taken by personnel working on or inspecting an open gear case?
1. Ridding themselves of loose articles that could fall into the gear case
2. Installing an adequate temporary closure for the gear case when necessary to leave it unattended
3. Lashing and securing needed tools or other devices that could fall into the gear case
4. Each of the above

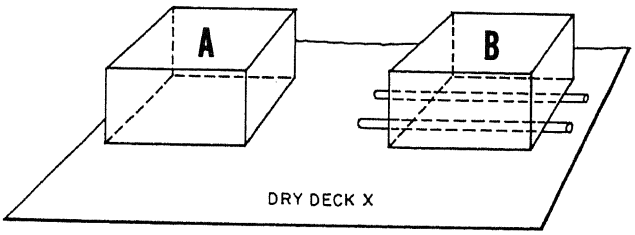
Assignment 5

Theory of Lubrication; Principles of Measurement

Textbook Assignment: Pages 112 - 151

Learning Objective: Identify the types of friction. Textbook page 112.

5-1. What is kinetic friction?
1. Friction between two bodies at rest
2. Friction that must be overcome to generate motion
3. Friction between moving bodies or between a moving body and a stationary surface
4. Friction that must be overcome to stop a body in motion



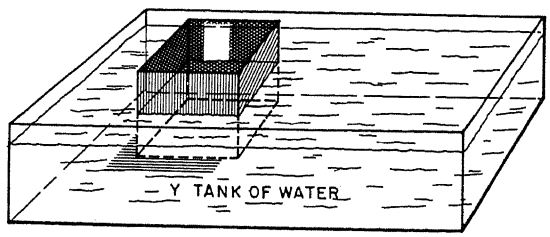


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Figure 5A.

● When answering items 5-2 through 5-8, refer to figure 5A.

5-2. What type of friction must be overcome to put boxes A and B in motion?
1. Fluid
2. Rolling
3. Sliding
4. Static

5-3. What type of friction exists between the deck and the bottom of box A as the box is dragged to point X?
1. Fluid
2. Rolling
3. Sliding
4. Static

5-4. What type of friction exists between the deck and the pipes under box B as the box is pushed to point X?
1. Fluid
2. Rolling
3. Sliding
4. Static

5-5. What type of friction exists between the water and the sides and bottom of box C as the box is floated to point Y?
1. Fluid
2. Rolling
3. Sliding
4. Static

Learning Objective: Recognize fundamentals of lubrication. Textbook pages 113 and 114.

5-6. Lubrication is applied to the moving parts of a machine to
1. reduce rusting and corrosion by preventing exposure of metal parts to oxygen
2. reduce friction by replacing sliding and rolling friction with fluid friction
3. prevent metal-to-metal contact by providing moving parts with friction-free surfaces
4. prevent losses of heat and energy by cooling moving parts

5-7. Friction existing between the water and the sides and bottom of the floating box is created by the forces that cause molecules of water to
1. attract one another
2. stick to the box
3. do both of the above
4. repel one another

5-8. Assume that boxes A and B are identical. Compare the amounts of power consumed and heat produced to overcome friction in moving box A with the corresponding amounts for overcoming friction in moving box B. What conclusion should you draw from the comparison?
1. More power is consumed and more heat is produced in moving box A.
2. More power is consumed and more heat is produced in moving box B.
3. More power is consumed and less heat is produced in moving box A.
4. More power is consumed and less heat is produced in moving box B.

5-9. Grease under pressure is able to resist breakdown because of its cohesive properties.

5-10. By introducing an unbroken film of oil between two parts that are making metal-to-metal contact, you reduce the friction between them. Theoretically, what kinds of friction are exchanged?
1. Sliding to rolling
2. Rolling to sliding
3. Sliding or rolling to fluid
4. Fluid to sliding or rolling

5-11. According to the Langmuir theory, lubricating oil between two moving surfaces consists of
1. several layers -- the outside layers adhering to the moving surfaces and the inside layer(s) sliding between the outside layers and remaining out of contact with the moving surfaces
2. two layers -- one sliding on the other and each layer clinging to one of the moving surfaces
3. one layer that prevents metal-to-metal contact and acts as a roller between the two moving surfaces
4. a wedge-shaped layer of oil that forces the moving surfaces apart as does a solid wedge

5-12. What effect, if any, does a change in temperature have on the oil film between two moving surfaces?
1. The film thickness changes with no change in viscosity.
2. The film thickness changes due to a change in viscosity of the oil.
3. The film thickness decreases with any change in temperature due to a change in the viscosity of the oil.
4. Temperature changes have no effect on the thickness of the oil film.

5-13. Compare the cohesive and adhesive properties of a lubricant, X, that is suitable for high speed operations and minimum clearances between bearing surfaces with those of another lubricant, Y, suitable for low speed operations and maximum clearances between bearing surfaces. What conclusion should you draw from the comparison?
1. X is more adhesive and more cohesive than Y.
2. Y is more adhesive and more cohesive than X.
3. X is more adhesive but less cohesive than Y.
4. Y is more adhesive but less cohesive than X.

5-14. A lubricant that is subjected constantly to high unit loads should be less cohesive than a lubricant subjected to low unit loads.

5-15. To meet required specifications, a lubricating oil for diesel engines must be able to
1. prevent metal-to-metal contact
2. keep the engines clean
3. prevent corrosion of bearing surfaces
4. do all the above

5-16. The compound type of lubrication oil prevents corrosion better than the standard mineral type because of
1. higher viscosity
2. higher specific gravity
3. lower pour point
4. additives

Learning Objective: Interpret symbols used to classify lubricating oils. Textbook page 114.

5-17. The digit, 2, in the lubricating oil symbol 2190T represents the
1. principal synthetic additive in the oil
2. class of the oil according to type and use
3. diameter, in centimeters, of the standard orifice used to measure the oil's viscosity
4. number of minutes it takes a 60-ml sample of the oil to flow through a standard orifice at a specified temperature

5-18. Which part of the lubricating oil symbol, 2190T, represents the viscosity of the oil?
1. 19
2. 90
3. 190
4. 219

5-19. What do the letters TEP indicate when they form part of the identifying symbol for a lubricating oil?
1. Oil has a high pour point.
2. Oil contains a special additive.
3. Oil is to be used for lubricating refrigerant compressors.
4. Oil is to be used for lubricating 2-cycle internal combustion engines.

Learning Objective: Give and apply the meanings of terms used to describe the characteristics of lubricating oils and greases. Textbook page 115.

5-20. The viscosity index of a lubricating oil indicates the changes in oil viscosity, other conditions remaining the same, due to variations in
1. temperature
2. pressure
3. moisture content
4. density

5-21. An oil that flows freely at low and at high temperatures is said to have a
1. high viscosity
2. high pour point
3. low viscosity index
4. high viscosity index

5-22. Under standard test conditions, the temperature at which the vapors of an oil will flash in the presence of a spark or flame is lower than the temperature at which the oil will burn.

5-23. The lowest temperature at which the vapors of an oil will burn in the absence of a spark or flame is known as
1. fire point
2. flash point
3. combustion point
4. auto-ignition point

5-24. Which index of a lube oil indicates the tendency of the oil to damage metal surfaces by oxidation?
1. Precipitation number
2. Flash point
3. Neutralization number
4. Pour point

5-25. What does the precipitation number of an oil represent?
1. Acid content
2. Additive content
3. Moisture content
4. Asphalt or carbon residue content

5-26. What grade of grease is used to lubricate parts that rotate at slow speeds under high pressures?
1. Soft
2. Hard
3. Medium
4. Medium-soft

Learning Objective: Point out fundamentals of purifying lube oil aboard ship. Textbook pages 115 through 118.

5-27. After prolonged use, an oil loses its capacity to lubricate due to the presence of contaminants, not wear.

5-28. The strainers and filters of a lubricating oil system are not suitable for removing which contaminant from the oil in the system?
1. Dirt
2. Water
3. Scale
4. Grit

5-29. Which of the following can be separated with a centrifugal purifier?
1. Salt from sea water
2. Water from lube oil
3. Gasoline from lube oil
4. Diesel fuel from lube oil

5-30. As oil mixed with water and sediment revolves rapidly in the bowl of a centrifugal purifier, each substance of the mixture is forced into a distinct layer. Where does the layer of sediment form?
1. At the top of the bowl
2. At the bottom of the bowl
3. Adjacent to the sides of the bowl
4. Adjacent to the axis of rotation

5-31. What is the main difference between the oil purifier in textbook figure 6-2 and the tubular-type purifier?
1. Basic principle of operation
2. Operating speed of the rotating element
3. Shape of the rotating element
4. Method of sludge disposal

5-32. What is the operating principle by which a disk-type centrifugal purifier removes contaminants from lubricating oil?
1. Oil entering at the top of the purifier flows downward through a stack of disks which entrap the contaminants; clean oil is spun inward to exit through a tubular shaft at the bottom.
2. Oil entering at the bottom of the purifier flows upward through a stack of disks which entrap the contaminants; clean oil is spun outward to exit from the neck of the top disk.
3. Oil entering at the top of the purifier flows downward through a tubular shaft, then upward through a stack of disks; contaminants are spun outward; clean oil is spun inward to exit from the neck of the top disk.
4. Oil entering at the bottom of the purifier flows upward through a tubular shaft, then downward through a stack of disks; contaminants are spun inward; clean oil is spun outward to exit from the neck of the bottom disk.

5-33. What is the function of the three-wing in a tubular-type oil purifier?
1. To keep the oil from emulsifying
2. To make the oil in the bowl rotate as fast as the bowl itself
3. To make the oil stream into the bowl in a jet
4. To permit the removal of solids from the bottom of the bowl

5-34. Which statement best describes oil purification by the batch process?
1. It is heated, allowed to settle, and then centrifuged after water and other impurities are removed.
2. It is cooled, allowed to settle, and then centrifuged after water and other impurities are removed.
3. It is constantly agitated while it is allowed to settle; then clarified after impurities have settled to the bottom.
4. It is heated as it settles, and then clarified after impurities have settled to the bottom.

Learning Objective: Identify the basic principles of measuring temperature, pressure, fluid flow, liquid level, rotational speed, specific gravity, and viscosity. Textbook pages 127 through 151.

5-35. What are the respective boiling points on the Celsius scale and Fahrenheit scale of pure water at atmospheric pressure?
1. 80° C; 200° F
2. 100° C; 212° F
3. 200° C; 80° F
4. 212° C; 100° F

5-36. Deleted.

5-37. What temperature scale is used worldwide for scientific work?
1. Celsius
2. Fahrenheit
3. Kelvin absolute
4. Rankine absolute

5-38. What is the basis for the Kelvin absolute seale established in 1954?
1. One fixed point at which water can exist as a solid, a liquid, and a vapor, when the pressure is kept constant
2. One fixed point at which water becomes a solid when the pressure is kept constant
3. Two fixed points; the points at which a liquid and its vapor, and a solid and its liquid may exist in phase equilibrium when the pressure is kept constant
4. Three fixed points; the points at which water exists as a solid, as a vapor, and as a liquid

5-39. A reading of 3 inches on the dial of a pressure gage calibrated in inches of water means that the measured pressure can support a
1. 1-inch column of water occupying 3 sq in. of space
2. 3-inch-high column of water
3. 33-inch-high column of water
4. 410-inch-high column of water

5-40. A gage reading of 3 inches of water is equal to a reading of
1. 0.240 in. of mercury
2. 4.53 in. of mercury
3. 0.108 psi
4. 9.92 psia

5-41. If an ordinary pressure gage indicates a pressure of 20 psi, what is the absolute pressure?
1. 5.3 psia
2. 9.80 psia
3. 24.50 psia
4. 34.7 psia

● When answering items 5-42 and 5-43 assume that atmospheric pressure is 31.40 inches of mercury absolute and that the respective pressures of containers A, B, C, and D are 12.60 psia, 14.70 psia, 15.43 psia, and 17.70 psia.

5-42. Which containers are under vacuum?
1. A and B
2. A and C
3. B and D
4. C and D

5-43. An approximate gage pressure for container C is
1. 0 psig
2. 2 psig
3. 4 psig
4. 6 psig

Learning Objective: Identify types and operating principles of the measuring devices used in a shipboard engineering plant. Textbook pages 128 through 151.

5-44. What is the principle of operation of the expansion thermometer?
1. The pressure of a gas at constant volume is directly proportional to temperature.
2. Expansion of the operating medium has a known relationship to temperature changes.
3. The operating medium can exist as a solid or a liquid at a specific temperature if the pressure is constant.
4. A definite relationship exists between the temperature of a liquid and the pressure of its vapor.

5-45. What factor determines the kind of liquid used in a thermometer?
1. The size of the instrument
2. The specific purpose for which the instrument is to be used
3. The expected life of the instrument
4. The temperature range in which the instrument is to be used

5-46. The purpose of the expansion chamber of a liquid-in-glass thermometer is to serve as a housing for an inert gas.

5-47. Each of the following is a purpose of the separable socket type of thermometer installation aboard ship except
1. protecting the thermometer from excessive pressures
2. protecting the thermometer from erosive fluids
3. eliminating the need for closing down a system in order to remove a thermometer
4. eliminating the time lag otherwise required by the thermometer to reach thermal equalibrium with the system in which temperature is being measured

5-48. How does the minimum thermometer in textbook figure 7-5 differ from the maximum thermometer in textbook figure 7-4? The minimum thermometer
1. is provided with a movable glass index; the maximum thermometer is not so provided
2. has a larger bore than the maximum thermometer
3. is an alcohol-in-glass thermometer; the maximum thermometer is a mercury thermometer
4. differs in all the above ways

5-49. What is the principle of operation of the bimetallic thermometer?
1. The expansion and contraction of metal is directly proportional to changes in temperature.
2. The amount of expansion or contraction of metals differs among the various metals.
3. The coefficient of linear expansion is the same for most metals.
4. Thin metal strips curve as they expand due to heat.

5-50. Which of the following thermometers would serve best as a recording instrument?
1. Liquid-in-glass
2. Minimum-maximum
3. Filled-system
4. Bimetallic

5-51. Which of the following types of thermometers indicates temperature changes as a result of pressure-volume changes?
1. Liquid-in-glass
2. Minimum-maximum
3. Filled-system
4. Bimetallic

5-52. On what principle does a Bourdon-tube gage work?
1. An increase in volume causes a straight elastic tube to expand.
2. A decrease in volume causes a coiled elastic tube to collapse.
3. A change in pressure causes a straight elastic tube to bend.
4. An increase in pressure causes a curved elastic tube to straighten.

In items 5-53 through 5-55, select the type of pyrometer from column B that measures temperature or temperature difference in terms of the quantity in column A.

A. Quantities	B. Types of Pyrometers
5-53. Opposition to current flow	1. Thermocouple
5-54. Generated voltage	2. Resistance
5-55. Brightness of light rays	3. Radiation
	4. Optical

5-56. Gages incorporating which type of elastic element are usually used to measure high vacuum?
1. Bourdon-tube elements
2. Diaphragm elements only
3. Bourdon-tube and bellows elements
4. Diaphragm and bellows elements

5-57. Differentiate between the functions of a simplex, duplex, and compound Bourdon-tube pressure gage.
1. Simplex--measures vacuum; duplex--measures vacuum and pressure; compound--measures more than one vacuum and pressure
2. Simplex--measures only one pressure; duplex--measures two pressures; compound--measures both vacuum and pressure
3. Simplex--measures vacuum; duplex--measures two pressures; compound--measures pressure at two or more different points at the same time
4. Simplex--measures one pressure; duplex--measures pressure and vacuum; compound--measures two pressures and vacuum

5-58. Which of the following gages would most likely be used in a system to indicate differential pressure directly?
1. Bourdon-tube vacuum gage
2. Bourdon-tube gage with two elements and one pointer
3. Vacuum gage with a bellows elastic element
4. Pressure gage with a diaphragm elastic element

5-59. Bellows elements are used in systems where the same pressure-sensitive device operates to indicate and to record pressures.

5-60. The amount that the metallic diaphragm in a pressure gage deflects is dependent on
1. the number of corrugations
2. the number of capsules
3. its design
4. all of the above factors

5-61. Bourdon tube pressure gages used to indicate steam pressure are protected against the existing high temperatures by
1. a column of water
2. a column of mercury
3. rubber insulation
4. metal insulation

5-62. The amount of fluid passing through a positive-displacement meter is proportional to the
1. pressure of the liquid against the measuring element
2. number of cycles of the measuring element
3. velocity of the fluid as it leaves the meter
4. number of deflections of the measuring element

5-63. Refer to figure 7-29 of the textbook. The volume of fluid that can pass through the meter per nutation of the piston is limited by the
1. size of the inlet
2. capacity of the measuring chamber compartments
3. size of the outlet
4. speed of the nutation piston

5-64. What is the principle of operation of head meters used to measure fluid flow?
1. The pressure increase in a fluid flowing through a restriction varies as the square of the fluid velocity.
2. The velocity decrease in a fluid flowing through a restriction is proportional to the rate of fluid flow.
3. Fluid pressure is least where velocity is greatest, and fluid velocity is greatest where flow capacity is least.
4. Fluid pressure is greatest where velocity is greatest, and fluid velocity is greatest where flow capacity is greatest.

5-65. A fluid flow area meter differs from a fluid flow head meter in that the area meter indicator
1. is greatly affected by the difference in pressure between two points in the flow line
2. shows fluid differential pressure which must be converted into a flow rate
3. is positioned directly by fluid pressure
4. shows exact fluid pressure

5-66. In both the rotameter and piston-type liquid flow area meters, the position of the piston or rotor is a direct indication of the fluid flow rate.

5-67. What characteristic of a liquid directly operates a static head gaging system of the type illustrated in textbook figure 7-32?
1. Volume
2. Weight
3. Pressure
4. Fluidity

5-68. What instrument is commonly used to measure the rotational speed of an engine crankshaft?
1. Manometer
2. Tachometer
3. Hydrometer
4. Barometer

5-69. Which of the following examples best illustrates the principle of operation of a centrifugal tachometer?
1. A man trying to lift himself by his shoes
2. A boy whirling a ball on the end of a rope
3. A ball falling on your head from the roof of a tall building
4. A car moving forward after the brakes are suddenly applied

5-70. The lamp in your room operates on alternating current. You are experimenting with a small electrical motor that has a small propeller on the end of its output shaft. You notice that at a certain speed the propeller appears to be motionless. The observation during your experiment is a good example of the principle of operation of what type of tachometer?
1. Stroboscopic
2. Resonance
3. Chromometric
4. Centrifugal

5-71. A certain solid has a specific gravity of 10. Since a cubit foot of water weighs 62.4 pounds, what is the density of the solid?
1. 62.4 lb
2. 624 lb
3. 62.4 lb/ft^3
4. 624 lb/ft^3

5-72. What is the principle of operation of a hydrometer? It tends to sink to a greater depth as
1. liquid volume decreases
2. liquid volume increases
3. liquid density decreases
4. liquid density increases

5-73. What is the approximate API gravity of a lubricating oil with a specific gravity of 0.92?
1. 9.2°
2. 22.3°
3. 102.5°
4. 153.8°

5-74. The Saybolt viscosimeter operates on the principle that at a given temperature the time for a certain quantity of liquid to flow through a small tube is proportional to the liquid's resistance to flow.

5-75. The time required for 60 cc of a certain oil at 122° F to flow through a Saybolt Furol orifice is 300 seconds. What is the viscosity of the oil?
1. 300
2. 5 SSF at 122° F
3. 300 SSU at 122° F
4. 300 SSF at 122° F

Assignment 6

Introduction to Thermodynamics

Textbook Assignment: Pages 157 - 184

Learning Objective: Recognize basic principles and laws concerning the conservation of energy and the exchange and transformation of energy. Textbook pages 157 through 184.

6-1. Which of the following definitions of energy is most adequate?
1. Energy is the capacity for producing an effect.
2. Energy is the capacity for doing work.
3. Energy is work being done.
4. Energy is power.

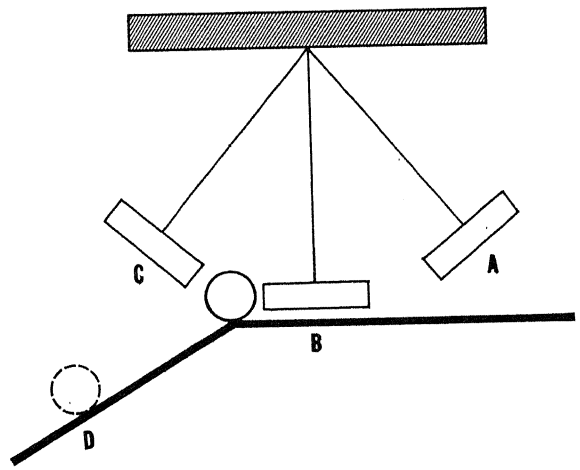

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Figure 6A.-Transformation of energy.

● Refer to figure 6A and select from the following alternatives when answering items 6-2 through 6-7.
1. Mechanical potential energy
2. Mechanical kinetic energy
3. Energy in transition
4. Potential and kinetic energy

6-2. When the hammer head is at A, the beginning of its swing, or at C, the end of its swing, the energy stored in it consists entirely of

6-3. Energy that the hammer head transfers to the ball on impact is

6-4. All the energy stored in the ball before it starts to roll is

6-5. When the hammer head is at B, the lowest point of its swing, the energy stored in it consists entirely of

6-6. Energy stored in the ball as it rolls by point D is

6-7. Energy stored in the hammer head as it nears the end of its swing consists of

6-8. What is the potential energy of a 200-pound statue that has been raised 50 feet above the ground by a crane?
1. 200 ft-lb
2. 250 ft-lb
3. 1,000 ft-lb
4. 10,000 ft-lb

6-9. Find the approximate kinetic energy of a bullet weighing 4 ounces if its velocity is 1,600 feet per second.
1. 7,000 ft-lb
2. 10,000 ft-lb
3. 22,000 ft-lb
4. 38,000 ft-lb

6-10. A man attempts to lift a 100-pound weight from the deck onto a shelf. Three feet from the floor the weight slips from his hands and drops to the deck. What is the net work performed?
1. 0 ft-lb
2. 100 ft-lb
3. 200 ft-lb
4. 300 ft-lb

6-11. How much time will it take a 3 horsepower machine to do 3300 ft lbs of work, using the formula $hp = \frac{Ewk}{550t}$, where t is the time in seconds that it takes a machine in horsepower (hp) to do an amount of work?
1. .5 sec
2. 1 sec
3. 2 sec
4. 3 sec

6-12. The magnitude of the internal energy of a substance is dependent upon
1. the mass of the molecules
2. the distance between the molecules
3. the activity of the molecules
4. all of the above factors

6-13. Differentiate between temperature and heat.
1. Temperature is internal kinetic energy and heat is a measure of this energy.
2. Temperature is a measure of thermal energy and heat is thermal energy in transition.
3. Heat is stored potential energy and temperature is kinetic energy in transition.
4. Heat is a property of a substance and temperature is the energy given off by the substance.

6-14. Which of the following units does not express a quantity of heat?
1. Calorie
2. British thermal unit
3. Degree
4. Joule

6-15. If you hold a piece of ice in your hand, by what mode does heat transfer from your hand to the ice?
1. Radiation
2. Convection
3. Conduction
4. Conduction or convection

6-16. Assume that heat is applied to one end of a long steel rod of uniform diameter until there is no difference in the temperatures of both ends of the rod. The total quantity of heat conducted through the rod is directly proportional to
1. the cross-sectional area of the rod
2. the thermal conductivity of steel
3. the thermal gradient and time during which heat flowed
4. all the above factors

● When answering item 6-17, refer to figure 8-1 in your textbook and assume the following values:
Specific heat of water = 1.00
Temperature of water in = 10° C
Temperature of water out = 15° C
Mass of water passing through chest = 1200 grams
t_1 = 75° C; t_2 = 45° C; L = 15 cm
Cross-sectional area of bar = 10 sq cm
Time during which heat flowed = 10 minutes

6-17. Compute the thermal conductivity of the bar.
1. 0.15
2. 0.50
3. 0.92
4. 1.01

6-18. The specific heats of substances are numerically equal in the metric and British systems of measurement.

6-19. Compute the specific heat of a metal for which the method of mixtures experiment yielded the following data:
Mass of metal = 150 grams
Mass of water = 215 grams
Specific heat of water = 1.00
Temperature of metal before mixing = 300°F
Temperature of water before mixing = 40° F
Temperature at which water and metal reach thermal equilibrium = 60° F
Heat absorbed by equipment = 20 calories
1. 0.09
2. 0.12
3. 0.20
4. 0.28

6-20. The specific heat of a substance is not affected by a change in its
1. pressure
2. volume
3. temperature
4. mass

6-21. Heat is transferred through a vacuum by
1. conduction
2. convection
3. radiation
4. all of the above modes

6-22. The thermal radiation of a perfectly black body is X. If the absolute temperature of the body is quadrupled, how much thermal radiation does the body emit?
1. X4
2. 4X
3. 16X
4. 256X

6-23. Convection is most useful as an aid in the heating of
1. solids
2. solids and liquids
3. solids and gases
4. liquids and gases

6-24. Which of the following objects or liquids is heated with the aid of natural convection?
1. The heating element of an electric stove
2. The water in a teakettle
3. An electric soldering iron
4. A light bulb

6-25. Forced convection is a mode of heat transfer that occurs in
1. a room heated with an electric heater
2. the heating of the water in a steam iron
3. a hot air furnace equipped with a blower
4. all of the above examples

6-26. Which of the following processes requires the removal of latent heat?
1. Solid to liquid
2. Gas to liquid
3. Liquid to gas
4. Solid to gas

6-27. What effect does the addition of heat to ice have on the amount of stored energy in the ice during the process of changing state?
1. Decreases internal potential energy.
2. Decreases internal kinetic energy.
3. Increases internal potential energy.
4. Increases internal kinetic energy.

6-28. At atmospheric pressure, the amount of latent heat that changes one pound of ice to water will change one pound of water to steam.

6-29. At atmospheric pressure, how much heat is required to change one pound of ice at 0° F to one pound of water at 32° F?
1. 16 BTU
2. 32 BTU
3. 160 BTU
4. 176 BTU

6-30. At atmospheric pressure, how much heat is required to change one pound of water at 112° F to one pound of steam at 212° F?
1. 100 BTU
2. 1,070 BTU
3. 1,082 BTU
4. 1,183 BTU

6-31. At atmospheric pressure, how much heat must be removed from one pound of steam at 300° F to drop its temperature 88° F without changing state?
1. 42 BTU
2. 88 BTU
3. 254 BTU
4. 1,112 BTU

6-32. What mode of heat transfer occurs in a surface heat exchanger?
1. Conduction
2. Convection
3. Radiation
4. Each of the above modes

6-33. Increasing the velocity of flow in a heat exchanger will
1. decrease heat transfer and increase the thickness of the fluid film
2. decrease heat transfer and decrease the thickness of the fluid film
3. increase heat transfer and decrease the thickness of the fluid film
4. increase heat transfer and increase the thickness of the fluid film

6-34. An increase in the amount of turbulence in the fluid flow in a heat exchanger has a tendency to increase heat transfer by
1. decreasing the thickness of the fluid film
2. decreasing the velocity of the fluid flow
3. increasing the thickness of the fluid film
4. increasing the velocity of the fluid flow

6-35. What type of flow is desirable in a heat exchanger used to manufacture ice?
1. Parallel flow
2. Cross flow
3. Single pass counter flow
4. Multipass parallel flow

6-36. Which of the following equation forms is the general energy equation for the conservation of energy principle?
1. One calorie of heat = 4.19 joules of work
2. Energy in = energy out
3. One BTU of thermal energy = 778 ft-lb of work
4. One joule of work = 778 ft-lb of work per BTU

6-37. According to the first law of thermodynamics, thermal energy can be transformed into mechanical energy without a loss of energy.

6-38. Assume that all the mechanical energy in a 20-pound sphere is converted into thermal energy as the sphere drops from a 195-foot height to the earth. The amount of mechanical energy converted is approximately equivalent to
1. 1 BTU
2. 5 BTU
3. 7 BTU
4. 9 BTU

6-39. Your lawn mower is powered by a 2 1/2 horsepower motor. If 10 percent of the energy produced by the motor is lost in the form of heat, what is the BTU loss per minute?
1. 1.76 BTU/min
2. 10.60 BTU/min
3. 26.50 BTU/min
4. 82.50 BTU/min

6-40. Which of the following factors are essential in a machine to qualify it as a thermodynamic system?
1. It must contain matter in a bounded region.
2. It must consist of solid matter and be capable of exchanging energy with another system.
3. It must be entirely real and capable of producing energy in the form of heat.
4. It must be a machine or similar object that operates on, and has an output of, thermal energy.

6-41. Bounce a rubber ball on the floor. At what point of the bounce between the floor and its maximum upward movement is the ball's kinetic energy greatest?
1. At the moment before it starts its upward movement
2. At the moment it leaves the floor and starts its upward movement
3. Midway between the floor and its maximum upward movement
4. At the moment before it reaches its maximum upward movement

6-42. Give an example of a thermodynamic process.
1. A ball hanging motionless on a line
2. A piece of ice in a container where ice and container are at the same temperature
3. Compressed gas in a cylinder at a constant temperature
4. A rock at 70° F on a block of ice

6-43. A stretched rubber band has a certain amount of potential energy stored in it.

6-44. If a force of 45 pounds is required to overcome sliding friction, how much work is done in sliding a 150-pound box 20 feet across a horizontal deck?
1. 900 ft-lb
2. 2,100 ft-lb
3. 3,000 ft-lb
4. 3,900 ft-lb

6-45. In which of the following machines is the thermodynamics process a non-flow process?
1. Turbine
2. Condenser
3. Centrifugal pump
4. Internal combustion engine

6-46. How much heat is added to, or removed from, the compressed air in a cylinder whose internal energy at the beginning and end of the non-flow process is 1200 and 1400 BTU, respectively, if the work done on the compressed air is 52,904 foot-pounds?
1. 132 BTU removed
2. 132 BTU added
3. 268 BTU removed
4. 268 BTU added

6-47. Which property of the working fluid in an ideal steady-flow system remains constant as the fluid proceeds from section to section?
1. Pressure
2. Temperature
3. Specific volume
4. Weight

6-48. With which forms of energy are steady-flow equations concerned?
1. Internal, thermal, and mechanical
2. Thermal, mechanical potential, and mechanical kinetic
3. Mechanical potential, mechanical kinetic, heat, and work
4. Work, flow work, internal, heat, mechanical potential, and mechanical kinetic

6-49. The combination of which forms of energy constitute the enthalpy of the working fluid in a steady-flow system?
1. Internal energy and heat
2. Work, flow work, and heat
3. Flow work and internal energy
4. Mechanical potential energy and mechanical kinetic energy

● In the textbook page 177, change the equation $H = \frac{pV}{J} + Btu$ to $H = \frac{pV}{J} + U$.

6-50. Which equation is used to calculate specific enthalpy in foot-pounds?
1. $H = U + \frac{pV}{J}$
2. $H = U + pV$
3. $h = u + \frac{pv}{J}$
4. $h = u + pv$

6-51. Which property of a working fluid remains constant in an isobaric state change?
1. Specific volume
2. Pressure
3. Temperature
4. Weight

6-52. Which property of a working fluid is kept constant in an isometric state change?
1. Specific volume
2. Temperature
3. Weight
4. Entropy

6-53. Which term describes the process in which the enthalpy of the working fluid at state 1 equals the enthalpy of the fluid at state 2?
1. Isothermal
2. Isenthalpic
3. Isentropic
4. Isometric

6-54. The work performed on or by the substance in an adiabatic process is equal to the net change of
1. temperature
2. internal energy
3. enthalpy
4. flow work

6-55. The thermodynamic cycle of a diesel internal combustion engine is an example of
1. an open and a heated engine cycle
2. a closed and a heated engine cycle
3. an open and an unheated engine cycle
4. a closed and an unheated engine cycle

6-56. What are the basic elements in a thermodynamic cycle?
1. Fuel, engine, heat source, combustion, and pump
2. Working substance, engine, heat source, heat receiver, and pump
3. Fuel, engine, heat source, working substance, and heat receiver
4. Working substance, heat source, combustion, heat receiver, and exhaust

6-57. The function of the steam turbines in a condensing steam power plant for ship propulsion is to
1. carry energy through the thermodynamic cycle
2. transform thermal energy of steam into work
3. absorb heat from steam
4. move steam through the thermodynamic cycle

6-58. Which element in the thermodynamic cycle of a gasoline engine moves the working substance from the low pressure side to the high pressure side?
1. Engine
2. Spark
3. Atmosphere
4. Piston

6-59. Theoretically what must be done to completely reverse a thermodynamic process?
1. Return the final conditions of the energy system and associated systems to the conditions in existence before the process started.
2. Return transformed or redistributed energy to its original form, amount, and location.
3. Do both of the above.
4. Return useful mechanical energy into thermal energy.

6-60. Which of the following is an inference drawn from the second law of thermodynamics?
1. Energy in the form of heat can be converted entirely to energy in the form of work.
2. An ideal engine can convert all its heat input into work output.
3. Heat of friction can reverse itself and perform work.
4. Heat cannot be converted to work unless a difference in temperature exists.

6-61. What is entropy?
1. Absolute value of the available energy in a thermodynamic process
2. A measure of the unavailable energy in a thermodynamic system
3. Temperature difference in an irreversible process
4. Flow of heat in a reversible process at absolute zero

6-62. When the temperature of an isolated thermodynamic system is absolute zero, the entropy value of the system is maximum.

6-63. Change in entropy of a system depends upon
1. the absolute temperature of the heat source
2. the absolute temperature of the heat receiver
3. the amount of heat transferred to or from the working fluid
4. all of the above factors

6-64. In a reversible isothermal process, which value is represented by the ratio of the heat supplied (BTU) to the absolute temperature of the process (°R)?
1. Total entropy of working substance at state 1
2. Total entropy of working substance at state 2
3. Difference in total entropies of working substance at states 1 and 2
4. Sum of total entropies of working substance at states 1 and 2

6-65. What should be the change in the total entropy of an isolated system when there is an increase in entropy in some parts of the system and a decrease in entropy in other parts of the system?
1. A decrease
2. An increase
3. Either an increase or a decrease depending on the absolute temperature of the heat source
4. Either an increase or a decrease depending on the absolute temperature of the heat receiver

6-66. According to the "heat death of the universe" concept, the ultimate result of the universe being in total equilibrium is a universe that is without
1. entropy
2. enthalpy
3. any energy
4. available and useful energy

6-67. The thermal efficiency of a Carnot-cycle engine depends on the
1. chemical properties of the working substance
2. type of engine used
3. nature of the heat producing process
4. difference in temperatures of the heat source and heat receiver

6-68. For a given weight of a gas, the product of its absolute pressure and volume, divided by its absolute temperature is
1. 48.3
2. 53.3
3. 55.0
4. a constant

● Many times in performing calculations with gas laws, you are not given the absolute temperature (°K). The temperature may be given in °C or °F, in which case the given temperature must be converted to °K (absolute). The methods for converting °C to °K and °F to °K are as follows:

1. Given °C, the absolute temperature (°K) is found by using the formula °K = °C + 273°. For example: To convert 27°C to °K, simply add

$$\begin{array}{r} 273^\circ \\ +27^\circ C \\ \hline 300^\circ K \end{array}$$ (absolute)

2. Given °F, the absolute temperature (°K) is found by first converting °F to °C and adding 273° as is shown above. To convert °F to °C use the formula $^\circ C = \frac{5}{9}(F-32)$. For example: To convert 41°F to °K, first find °C as follows: $^\circ C = \frac{5}{9}(41-32) = \frac{5}{9}(9) = 5^\circ C$, and then add,

$$\begin{array}{r} 273^\circ \\ +\ 5^\circ C \\ \hline 278^\circ K \end{array}$$ (absolute)

6-69. At 40° F, the air pressure in a truck tire is 75 psi absolute. Assuming no change in volume, calculate the air pressure when the temperature goes up to 100° F as the truck is driven on the road.
1. 60 psia
2. 84 psia
3. 115 psia
4. 140 psia

6-70. A closed container partially filled with water is being heated. When will equilibrium pressure be established?
1. When the water temperature is numerically equal to the gas constant for air
2. When the water pressure equals atmospheric pressure
3. When the velocity of the water molecules equals the velocity of the vapor molecules
4. When the number of molecules escaping from the water equals the number of vapor molecules entering the water

6-71. A teakettle filled partially with water is being heated. The opening in the teakettle permits the vapor to leave the steam at the evaporation rate. Describe the pressure and temperature conditions of the water and vapor.
1. Critical pressure and critical temperature
2. Supercritical pressure and supercritical temperature
3. Equilibrium pressure and equilibrium temperature
4. Saturation pressure and saturation temperature

6-72. What is the descriptive term for a liquid which is under a certain pressure and at the saturation temperature for that pressure?
1. Saturated liquid
2. Superheated liquid
3. Evaporated liquid
4. Subcooled liquid

6-73. What is the temperature change relationship between a subcooled liquid and its vapor as they are heated together to saturated temperature?
1. The vapor temperature is constant while the liquid temperature increases.
2. The vapor temperature increase is small compared to the liquid temperature increase.
3. The vapor temperature increase is greater than the liquid temperature increase.
4. The temperature increase is the same for both vapor and liquid.

6-74. What is the degree of superheat when saturated steam, at a pressure of 1,200 psia and a corresponding saturation temperature of 649.5°F, is superheated to 909.5°F?
1. 260°F
2. 649.5°F
3. 909.5°F
4. 1,559°F

Assignment 7

Introduction to Thermodynamics (continued); Machinery Arrangement and Plant Layout

Textbook Assignment: Pages 184 - 223

Learning Objective (continued): Recognize basic principles and laws concerning the conservation of energy and the exchange and transformation of energy. Textbook pages 184 through 190.

7-1. When a saturated liquid cannot be distinguished from its saturated vapor and its physical state is unaffected by increases in pressure or temperature it is said to be
1. supersaturated
2. subcritical
3. critical
4. supercritical

● When answering items 7-2 through 7-8, refer to figure 8-11 of the textbook.

7-2. What is the approximate boiling point of water when its saturation pressure is given as 185.3 psig?
1. 370° F
2. 382° F
3. 391° F
4. 400° F

7-3. What is the specific volume of steam when the saturation pressure is given as 250 psia and the corresponding saturation temperature is 400.95° F?
1. 0.01833 cu ft/lb
2. 0.01865 cu ft/lb
3. 1.8438 cu ft/lb
4. 2.404 cu ft/lb

7-4. By how much does the enthalpy of 1 pound of saturated water at 250 psia and 400.95° F exceed the enthalpy of saturated water at 0.08854 psia and 32° F?
1. 344 BTU
2. 351 BTU
3. 355 BTU
4. 376 BTU

7-5. How much heat must be supplied to change 1 pound of saturated water to saturated steam at 200 psia and 381.79° F?
1. 355 BTU
2. 376 BTU
3. 825 BTU
4. 843 BTU

7-6. The zero point for entropy of saturated water is the same as the zero point for enthalpy of saturated water.

7-7. The entropy of 1 pound of saturated steam at 0.08854 psia and 32° F equals the entropy of the saturated water plus the entropy of evaporation at the zero point.

7-8. The internal energy of 1 pound of saturated water at 190 psia and 377.51° F is the same as the enthalpy of the saturated water.

7-9. What is a disadvantage in using a three-dimensional surface to show the relationships among the pressure, volume, and temperature of a working fluid?
1. The surface cannot be plotted on a rectangular coordinate system.
2. The surface is difficult to analyze in detail.
3. The surface must be projected from a two-dimensional diagram.
4. The surface does not give an overall picture of the relationships involved.

7-10. Construct a p-T diagram to represent an isometric (constant volume) compression of 1 pound of air from an initial pressure of 1,000 psfa to a final pressure of 6,000 psfa. Assume a volume of 10.66 cubic feet. On what geometric figure do the plotted values lie?
1. Straight line
2. Parabola
3. Hyperbola
4. Semi-ellipse

7-11. The liquid-vapor equilibrium curve of the textbook figure 8-17 indicates the effects of pressure on the
1. melting point of ice
2. freezing point of water
3. boiling point of water
4. sublimation point of vapor

7-12. What is the triple point of water?
1. Pressure and volume at which water at a given temperature can exist as a saturated vapor.
2. Volume and temperature at which water under constant pressure can exist as a solid.
3. Pressure and temperature at which a fixed volume of water can exist as a solid, a liquid and a vapor.
4. Volume, pressure, and temperature at which water can exist as ice.

7-13. At what point in the propulsion cycle is chemical energy transformed into thermal energy?
1. Deaerating feed tank
2. Condenser
3. Boiler furnace
4. Economizer

7-14. Refer to figure 8-18 of the textbook. The main energy transformations involved in converting thermal energy of steam to work in the turbines take place in the
1. nozzles and turbine blades
2. furnace and superheater
3. condensate pump and main feed pump
4. deaerating feed tank and condenser

7-15. At what point in the propulsion cycle is thermal energy of auxiliary steam transformed into mechanical energy?
1. Condensate pump
2. Air ejector condenser
3. Deaerating feed tank
4. Economizer

Learning Objective: Identify the purposes and components of energy balances for shipboard engineering plants. Textbook page 190.

7-16. The engineer officer of a naval ship makes energy balances to determine whether or not the ship's engineering plant is operating at designed efficiency or making efficient use of steam, fuel, and energy.

7-17. What are the important entries to be made at various points in the flow diagram that constitutes the energy balance for a ship's engineering plant?
1. Quantities of working fluid flowing per hour
2. Data on the thermodynamic states of the working fluid
3. Enthalpy calculations
4. All the above

Learning Objective: Point out some arrangements of propulsion machinery in naval ships. Textbook pages 193 through 195.

7-18. Which statement pertaining to propulsion machinery spaces and their arrangement aboard ship is true?
1. Many large ships of recent design have machinery rooms instead of the firerooms and enginerooms found on older ships.
2. Large ships have one fireroom for each engineroom.
3. On ships of recent design, machinery rooms contain the propulsion turbines and the boilers that serve them are located in other spaces.
4. Firerooms aboard ship usually contain the boilers and propulsion turbines with operating stations located in spaces called enginerooms.

7-19. Which propulsion units are located on the upper level of a machinery room?
1. Boilers
2. Condensers
3. Propulsion turbines
4. Main reduction gears

7-20. Each of the four main engines on CVA43 is served by three boilers. The boilers serving the No. 2 main engine are identified by numbers
1. 1A, 3A, and 5A
2. 2A, 2B, and 2C
3. 2B, 4B, and 6B
4. 4A, 4B, and 4C

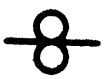
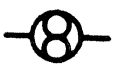
7-21. The machinery arrangement illustrated in figure 9-8 of the textbook is designed to provide
1. maximum resistance to damage
2. greater reliability in split-plant operation
3. maximum efficiency in cross-connected operation
4. ease in maintenance while the ship is underway

Learning Objective: Recognize the engineering symbols and markings used with engineering piping systems. Textbook pages 195 through 204.

For items 7-22 through 7-24 select from column B the symbol for the type of valves in column A.

A. Types of Valves	B. Symbols
7-22. Gate stop valve	1. 
7-23. Pressure regulating weight-loaded valve	
7-24. Swing check valve	2. 
	3. 
	4. 

For items 7-25 through 7-28 select from column B the symbol for the unit in column A.

A. Units	B. Symbols
7-25. Rotary pump	1. 
7-26. Steam turbine	
7-27. Duplex strainer	2. 
7-28. Bucket trap	3. 
	4. 

7-29. What kind of pipes are frequently marked with attached label plates instead of being stenciled?
1. Pipes that run through extremely hot areas
2. Pipes that are exposed to the elements
3. Pipes with outside diameters of less than two inches
4. Pipes that are located in inside compartments away from natural daylight

7-30. The identification marking, 1-67-2, attached to a valve indicates that the valve is located near frame 67 on which deck?
1. Main deck, port side
2. Second deck, starboard side
3. Main deck, starboard side
4. Second deck, port side

7-31. Which of the following shipboard valves should be identified by a casualty control identification number?
1. Remote-operated fuel oil valve
2. Main steam line stop valve
3. Auxiliary exhaust stop valve
4. All the above

7-32. A certain line valve aboard ship is marked 2MS3A. Identify the valve.
1. The second main line valve in the plant 3 system.
2. The third main line valve in the main steam system of plant 2.
3. The second main service valve of plant 3.
4. Main steam cross connection to auxiliary steam in plant 2.

7-33. JP-5 piping valves in interior spaces are identified by what color?
1. Green
2. Yellow
3. Red
4. Purple

7-34. What color identifies an oxygen valve?
1. Red
2. Purple
3. Green
4. Yellow

Learning Objective: Recognize the piping systems aboard ship and the functional relationships of the systems to the overall operation of the propulsion plant. Textbook pages 205 through 223.

7-35. The main difference between the high pressure main steam system and the low pressure main steam system aboard ship is in the
1. amount of steam supplied by the systems
2. kind or composition of metals used for piping and fittings
3. size of the piping and fittings
4. number of applications

7-36. Valves that control the flow of superheated steam in most shipboard piping systems belong to the
1. 100 psig auxiliary steam system
2. 150 psig auxiliary steam system
3. boiler feed system
4. main steam system

7-37. A certain ship has four firerooms and each fireroom is equipped with one boiler. How many boiler stop valves are there in the main steam system, and from where are they operated?
1. Two; operated from No. 1 and No. 3 firerooms
2. Four; operated from the firerooms in which they are located or remotely from the main deck
3. Six; operated remotely from the main deck
4. Eight; operated at the points of location or remotely from the main deck

7-38. The cross connection piping illustrated in textbook figure 9-12 serves to permit
1. operation of the two propulsion units and turbogenerators with either boiler
2. operation of the two propulsion units and turbogenerators with both boilers
3. the superheated steam to by-pass the high pressure turbine
4. both 1 and 2 above

7-39. The soot blowers for the No. 4 boiler on CA-139 class heavy cruisers operate on
1. superheated steam
2. 600-psi saturated steam
3. 150-psi saturated steam
4. exhaust steam

7-40. A significant difference between the main steam systems of DLG14 and DD692 is that the 1200-psi main steam system supplies steam to
1. the soot blowers but not to the main feed pumps; the reverse is true for the 600-psi system
2. the main feed pumps but not to the soot blowers; the reverse is true for the 600-psi system
3. all units inside and outside of the engineering spaces; the 600-psi system supplies steam to units inside the engineering spaces
4. all units inside and outside the engineering spaces except the main feed pumps; the 600-psi system supplies steam to all units except the soot blowers

7-41. On ships having double-furnace boilers, auxiliary steam is made up of
1. superheated steam at steam drum pressure and temperature
2. saturated steam at steam drum pressure and temperature
3. desuperheated steam at steam drum temperature
4. desuperheated steam at steam drum pressure

7-42. In serving the main air ejector in the No. 4 machinery room of a CA-139 class heavy cruiser, auxiliary steam at 600-psi passes through a
1. 600- to 150-psi reducing valve
2. 600- to 275-psi reducing valve
3. 160-psi relief valve
4. 150-psi reducing station

7-43. The forward plant and the after plant of the DLG14 or 15 each have one boiler to supply steam for the 1200-psi auxiliary steam system of each plant and a second boiler to serve only the 600-psi auxiliary steam system.

7-44. If the auxiliary exhaust system of a ship having a 1200-psi main steam system falls below a set minimum pressure it will normally be augmented by the
1. 50-psi auxiliary steam system
2. 150-psi auxiliary steam system
3. 600-psi auxiliary steam system
4. 2000-psi auxiliary steam system

7-45. The 150-psi auxiliary steam system of DLG15 provides steam for
1. lube oil purifier heaters
2. fuel oil heaters
3. burner cleaning services
4. all of the above units

7-46. The temperature of the fireroom 150-psi steam system on DLG15 is reduced to 400°F by
1. the reducing stations in the firerooms
2. the boiler casing steam smothering system
3. a spray-type desuperheater
4. an auxiliary exhaust system

7-47. What are the source and temperature of the steam supplied to the distilling plant air ejectors described in textbook figure 9-18?
1. 100-psi auxiliary steam system; 385°F
2. 50-psi constant service steam system; 400°F
3. Fireroom reducing staions; 400°F
4. Engineroom reducing stations; 610°F

7-48. One way of relieving pressure in excess of 15 psig from an auxiliary exhaust system is to allow excess steam to enter the main condenser. This pressure is relieved automatically by means of
1. unloading valves
2. relief valves
3. reducing valves
4. augmenting valves

7-49. Leakage of air into the turbine casing through the turbine shaft glands is prevented by
1. air pressure
2. steam condensate
3. high pressure steam
4. gland sealing steam

7-50. Refer to textbook figure 9-20. At what unit does the condensate system end, and the feed system begin?
1. Deaerating feed tanks
2. Economizer
3. Main condenser
4. Main feed pump

7-51. Designers of feed systems are constantly striving to design systems that will be able to
1. operate on lower pressure
2. remove more efficiently the dissolved oxygen from feed water
3. lower the temperature of feed water
4. do all of the above

7-52. Most modern naval vessels utilize a feed system that operates under
1. a vacuum
2. atmospheric pressure
3. positive pressure
4. negative pressure

7-53. Steam exhausting into the main condenser from propulsion turbines is changed to water when it comes in contact with tubes through which
1. feed water flows
2. sea water flows
3. condensate flows
4. deaerated water flows

7-54. Condensate, while enroute from the main condenser to the deaerating feed tank, is utilized as a condensing and cooling agent in the
1. vent condenser, auxiliary condenser, air ejector condenser
2. air ejector condenser, gland exhaust condenser, evaporators
3. gland exhaust condenser, air ejector condenser, vent condenser,
4. main condenser, auxiliary condenser, vent condenser

7-55. Feed systems, unlike steam systems, cannot be operated either split-plant or cross-connected.

7-56. The auxiliary condenser in a condensate and feed system differs from the main condenser in
1. capacity
2. function
3. purpose
4. all of the above aspects

7-57. The piping systems which assist the auxiliary exhaust system and the condenser in returning used water to the feed system are called
1. collecting systems
2. dumping systems
3. exhausts
4. drains

7-58. Steam and water from which of the following equipment drain into the high pressure steam drainage system?
1. Steam tables in the galley
2. Pressing machines in the tailor shop
3. Presses in the laundry
4. Steam catapults on an aircraft carrier

7-59. What drainage system collects uncontaminated drains from the low pressure steam piping systems and steam equipment located outside of the machinery spaces?
1. High pressure steam
2. Oil heating
3. Service steam
4. Fresh water

7-60. Contaminated drains of the service steam drainage system are discharged to the
1. sea
2. low pressure drain system
3. bilges
4. high pressure drainage system

7-61. An inspection tank is used to collect drains from the
1. high pressure drainage system
2. oil heating drainage system
3. service steam drainage system
4. fresh water drain collecting system

7-62. Which tank collects contaminated drains from machinery located in an auxiliary machinery space?
1. Bilge sump tank in the main machinery space
2. Bilge sump tank in the auxiliary machinery space
3. Fresh water drain collecting tank in the main machinery space
4. Fresh water drain collecting tank in the auxiliary machinery space

7-63. Main fuel oil storage tanks are found in all of the following spaces except
1. forward of the machinery spaces
2. aft of the machinery spaces
3. abreast of the machinery spaces
4. in double-bottom compartments directly under boilers

7-64. After water and other impurities are removed from contaminated oil settling tanks, the remaining oil is
1. discharged overboard
2. offloaded to oil barges in port
3. transferred to a storage or service tank
4. burned as waste oil at sea

7-65. The purpose of fuel oil tank vent pipes is two-fold: to allow the escape of vapor and to allow
1. transfer of oil between tanks
2. the entrance of air when oil is withdrawn from the tank
3. pressure filling of the tanks
4. overflow in case of oil expansion

7-66. The fuel oil filling and transfer system is used for all of the following operations except
1. filling the fuel oil service tanks
2. changing the list of the ship
3. clearing the fuel oil storage tanks of sludge and water
4. changing the trim of the ship

7-67. Which of the following shipboard systems discharges dirty oil overboard or to contaminated oil settling tanks?
1. Fuel oil service system
2. Fuel oil tank stripping system
3. Fuel oil filling and transfer system
4. Ballasting and flooding system

7-68. When the fuel oil service system on a ship includes return-flow atomizers, coolers are also required in the system to keep the oil temperature below the flash point.

7-69. Differentiate between the port and cruising fuel oil service pumps, and the main fuel oil service pumps, on ships of recent manufacture.
1. Main fuel oil service pumps are herringbone gear type; port and cruising fuel oil service pumps are axial-piston type.
2. Main fuel oil service pumps have capacity adjustments; port and cruising fuel oil service pumps cannot be adjusted.
3. Main fuel oil service pumps are used when neither steam nor electricity is available; port and cruising fuel oil service pumps are used only when steam is available.
4. Main fuel oil service pumps are driven by steam turbines; port and cruising fuel oil service pumps are driven by two-speed electric motors.

7-70. Hand or emergency fuel oil service pumps are used aboard ships to
1. light off boilers when neither steam nor electric power is available
2. recirculate unused oil from the main pump discharge to the pump suction
3. increase the pumping capacity of the port and cruising fuel oil service pumps
4. remove contamination when the main service pumps take suction from a service tank

7-71. What must you do to line up the pumps of a fuel service system for pumping oil to the boilers?
1. Close the quick-closing valves.
2. Close the micrometer valves.
3. Open the suction and discharge valves.
4. Close the main fuel oil valves.

Assignment 8

Machinery Arrangement and Plant Layout (continued); Propulsion Boilers

Textbook Assignment: Pages 223 - 259

● Make the following correction to your textbook:

Page	Column	Change
226	right	In paragraph 2, line 5, change "200 psi" to read "20 psi"

Learning Objective (continued): Recognize the piping systems aboard ship and the functional relationships of the systems to the overall operation of the propulsion plant. Textbook pages 223 through 229.

8-1. Refer to textbook figure 9-21. Why are the fuel oil meter valves closed?
1. To prevent oil from going through the atomizer
2. To prevent oil from passing through the fuel oil meter when oil is being recirculated
3. To bypass the heaters
4. To increase a low oil pressure

For items 8-2 through 8-4, select from column B the fuel oil service system valve that performs the function in column A.

	A. Functions	B. Valves
8-2.	Controls oil flow to boilers	1. Burner root valve
8-3.	Controls oil pressure to burners in operation	2. Atomizer valve
8-4.	Stops oil flow to unused burners	3. Main fuel oil valve
		4. Micrometer valve

8-5. If the temperature of the oil in a burner manifold is too low for lighting off, what action do you take?
1. Adjust the burner micrometer valve.
2. Adjust the burner atomizer valve.
3. Open the burner recirculating valve.
4. Open the check valve in the appropriate recirculating line.

8-6. What prevents the back flow of oil from the fuel oil suction main?
1. A check valve in the recirculating line
2. A check valve at the connection of the clearing line
3. An emergency quick-closing valve in the service line
4. A recirculating valve at the burner manifold

8-7. Ballasting tanks are filled with fresh water and are emptied by gravity drains.

8-8. Which of the following statements is true?
1. Although the diesel oil system aboard ship is separate from the boiler fuel oil system, the diesel oil system is so arranged that diesel oil can be discharged to the fuel oil system.
2. The diesel oil system aboard a ship is usually an integral part of the boiler fuel oil system.
3. Although an emergency may exist, JP-5 aviation fuel may not be used as boiler fuel on aircraft carriers.
4. The JP-5 aviation fuel system aboard aircraft carriers is an integral part of the boiler fuel oil system.

8-9. Which lube oil service pump is used while the ship is getting underway?
1. The shaft-driven pump
2. The turbine-driven pump
3. The motor-driven pump
4. Each of the above

8-10. Which air system aboard ship is used for torpedo charging?
1. Ship's service compressed
2. Aircraft starting and cooling
3. Oxygen-nitrogen producer
4. High pressure

8-11. The ship's service air system provides compressed air for which of the following uses?
1. Operating oil-burning forges and furnaces
2. Cleaning equipment and charging air pump chambers
3. Operating pneumatic tools
4. All of the above and other uses

8-12. What is a normal air pressure used for removing ballast from tanks aboard ship?
1. 120 psi
2. 200 psi
3. 520 psi
4. 600 psi

8-13. What type of naval ship firemain system consists of two single fore-and-aft cross-connected mains generally installed on the damage control deck?
1. Single main system
2. Horizontal loop system
3. Vertical loop system
4. Either 1 or 3 above

8-14. Air chambers are installed in shipboard flushing systems to reduce water hammer.

8-15. What is the function of the secondary drainage system aboard ship?
1. Removing waste fluids from urinals and water closets
2. Conveying waste water from the galley and decks
3. Supplementing the ship's main drainage system
4. Supplementing the plumbing and deck drains

8-16. How are the wet sprinkler system control valves operated?
1. Manually
2. Thermally
3. Hydraulically
4. Electrically

8-17. What is the medium used to transmit force in high pressure hydraulic systems aboard ship?
1. Air pressure
2. Phosphate ester fluid
3. Petroleum-base hydraulic oil
4. Water

Learning Objective: Point out modes of operation of a propulsion plant. Textbook page 229.

8-18. What is meant by split-plant operation on a ship with four complete engineering plants?
1. Only one main engine is operating.
2. Engines No. 1 and No. 2, or No. 3 and No. 4, are operating; engine No. 1 receiving steam from boiler No. 2, and engine No. 2 receiving steam from boiler No. 1, or engine No. 3 receiving steam from boiler No. 4, and engine No. 4 receiving steam from boiler No. 3.
3. All engines are operating and receiving steam from the same boiler or boilers.
4. Each plant is operating independently.

8-19. A certain ship has four complete engineering plants so designed that the two forward plants can be cross-connected and the two after plants can be cross-connected, but that neither of the two forward plants can be cross-connected with the two after plants. When the two forward plants are cross-connected and the two after plants are cross-connected, the operation is known as
1. split-plant operation
2. cross-connected operation
3. group operation
4. cross-connected split-plant operation

Learning Objective: Recognize or apply definitions of standard boiler terms. Textbook pages 230 through 232.

8-20. The required pounds of steam generated per hour to develop contract shaft horsepower, maintaining specified pressures and temperatures, divided by the number of boilers installed would give the
1. overload capacity for each boiler
2. efficiency of each boiler
3. efficiency of each fireroom
4. full-power capacity of each boiler

8-21. Boiler overload capacity is boiler full power plus
1. 10%
2. 20%
3. 30%
4. 40%

8-22. The controlling pressure of the power plant on a combatant ship that is operating at full power capacity is the same as which of the following pressures?
1. Superheater outlet
2. Steam drum
3. Operating
4. All of the above pressures

8-23. The designed pressure in psi of a boiler whose steam drum pressure is given by the manufacturer as 1,260 psi is approximately
1. 1,225
2. 1,250
3. 1,275
4. 1,300

8-24. At a specified rate of operation, which of the following designates the intended maximum operating temperature of the superheater outlet?
1. Superheater temperature
2. Boiler temperature
3. Operating temperature
4. Design temperature

8-25. How is the efficiency of a boiler computed?
1. By dividing the heat it uses by the heat available
2. By dividing the heat available by the heat it uses
3. By subtracting the design temperature of the boiler from its operating temperature
4. By subtracting the operating temperature of the boiler from its design temperature

8-26. Which of the following factors accounts for the difference between boiler efficiency and fireroom efficiency?
1. The difference between design and operating pressures
2. The difference between design and operating temperatures
3. Amount of steam consumed by the blowers and pumps
4. Amount of water consumed by the boilers

8-27. The total heating surface of a modern boiler equals the sum of the
1. generating surfaces
2. generating and superheater surfaces
3. generating and economizer surfaces
4. generating, superheater, and economizer surfaces

Learning Objective: Identify principles of boiler classification. Textbook pages 232 through 234.

8-28. Classification of boilers according to the relative location of the fire and water spaces may be divided into fire-tube and water-tube boilers.

8-29. What causes water circulation in natural circulation boilers?
1. The difference between the density of ascending cool steam-free water and a descending mixture of hot water and steam
2. The difference between the density of ascending hot water and steam and a descending body of relatively cool steam-free water
3. Convection currents created by the even heating of the water
4. Pressure created by the accelerated, but uneven, heating of the water

8-30. Circulation of water in a natural circulation boiler is accelerated by installing
1. larger downcomers
2. down flow tubes outside the furnace
3. the generating tubes at a greater angle of inclination
4. the generating tubes at a lesser angle of inclination

8-31. Boilers that depend on pumps to circulate water are classified as controlled circulation boilers.

8-32. Which of the following types of boilers operate without water drums?
1. Drum-type boilers
2. Header-type boilers
3. Controlled circulation boilers
4. All natural circulation boilers

8-33. Classified according to furnace arrangement, the D-type boiler is
1. a double-furnace boiler
2. a single-furnace boiler
3. either a single-furnace or double-furnace boiler
4. a divided-furnace boiler

8-34. One way of classifying modern naval boilers is according to the pressure that the furnace operates under. Using this method, a boiler with a furnace operating pressure of approximately 65 psi would be classified as a
1. high pressure M-type
2. high pressure D-type
3. nonpressurized-furnace type
4. pressurized-furnace type

8-35. In which type of superheater are the superheater tubes of a boiler protected from the radiant heat of the furnace by water screen tubes?
1. Convection-type
2. Radiant-type
3. Controlled
4. Uncontrolled

8-36. Boilers should be identified as to whether they have or do not have superheat control because recent developments in boiler design make controlled superheat possible regardless of the number of furnaces in a boiler.

8-37. Can boilers be classified precisely according to operating pressure? If so, why? If not, why not?
1. Yes; operating pressures are stable for a group of boilers.
2. No; operating pressures vary within a group.
3. Yes; operating pressures tend to remain standardized even though boiler models are modified.
4. Yes; a boiler described as a 400-psi, a 600-psi, or a 1200-psi boiler normally operates at described pressure.

Learning Objective: Identify boiler components and their functions. Textbook pages 235 through 244.

8-38. What is the purpose of the steam drum on a boiler?
1. To equalize the distribution of water to the generating tubes
2. To provide a place for the accumulation of loose scale
3. To provide a place for heating the water and storing superheated steam
4. To receive feed water and accumulate saturated steam

8-39. A function of the boiler water drum is to
1. provide a reservoir for the water required for boiler operation
2. provide space for the separation of water from the steam before it leaves the boiler
3. receive excess water from the down comers and the generating tubes
4. equalize the distribution of water to the generating tubes

In items 8-40 through 8-43, select from column B the tubes that have the function in column A.

A. Functions	B. Tubes
8-40. Maintain boiler circulation	1. Generating
	2. Water wall
8-41. Protect superheater	3. Water screen
8-42. Produce most of the saturated steam	4. Downcomer
8-43. Protect furnace refractories	

8-44. The function of the division plates in the superheater headers is to
1. direct the flow of feed water
2. direct the flow of steam
3. separate the steam from the water
4. separate the scale from the steam

8-45. The number of times that steam passes through the superheater depends upon
1. the temperature of the steam
2. the number of header divisions
3. the relative locations of the steam inlet and the steam outlet
4. both 2 and 3 above

8-46. What is the function of boiler economizers?
1. To recirculate water to conserve its thermal energy
2. To slow down the flow of feed water to permit faster heating
3. To carry feed water through rising gases of combustion to permit transfer of heat from the gases to the water
4. To separate steam from feed water to reduce the loss of steam

8-47. A fuel oil burner, regardless of type, serves primarily to mix fuel and air for combustion.

8-48. One of the main purposes of refractories in the boiler furnace is to
1. protect economizers from excessive heat
2. help maintain a high temperature in drums and headers
3. prevent excessive furnace heat losses
4. help preheat air

8-49. What part of a boiler installation is the furnace?
1. The space enclosed by the boiler inner casing
2. The space between the boiler inner and outer casings
3. The space immediately surrounding the boiler outer casing
4. The space that houses the superheater tubes

8-50. What usually joins a boiler to the smokepipe?
1. Inner casing
2. Outer casing
3. Inner and outer casing
4. Uptakes

8-51. What is the purpose of the elongated holes in the bottom flange of one of the saddles that supports a boiler water drum?
1. To simplify the removal of the water for inspection or repair
2. To permit the installation of gaskets for airtight sealing
3. To permit movement when the water drum contracts and expands due to temperature changes
4. To permit rapid and accurate adjustment when installing the water drum

8-52. The flanged portions of saddles that are not fastened rigidly to the adjoining supports are called boiler
1. expansion joints
2. sliding feet
3. connecting elements
4. sliding feet or connecting elements

Learning Objective: Recognize or apply principles of identifying boiler tubes. Textbook page 236.

8-53. What is the standard way of identifying boiler tubes of drum-type boilers by means of letters and numbers?
1. Rows of tubes are lettered; separate tubes in each row are numbered.
2. Rows of tubes are numbered; separate tubes in each row are lettered.
3. Rows of tubes are alternately numbered and lettered, starting with numbers.
4. Rows of tubes are alternately lettered and numbered, starting with letters.

8-54. Assume a boiler had 31 rows of generating and circulating tubes in a tube bank. What identifying letters or numbers would be the correct identification for the fifth tube from the front of the boiler in the twenty-ninth row of tubes?
1. BB-5
2. Z3-5
3. 29-5
4. CC-5

8-55. Assume the row and tube identification of a water wall tube is followed by the letter R. This letter designation means the tube was
1. regular in size
2. bent for a left-hand boiler
3. studded on the right-hand side
4. regular and had no studs attached

Learning Objective: Identify the types of propulsion boilers used in the Navy and point out some of the construction and operational features. Textbook pages 245 through 261.

8-56. What determines the number of header sections per boiler and where are they located?
1. Size of the boiler; half of them are located under the steam drum at the front of the boiler and the others are located at the rear of the boiler
2. Size of the boiler; they are located at the front and at the rear of the steam drum
3. Design temperature of the boiler; half of them are located under the steam drum at the front of the boiler; and the others are located at the rear of the boiler
4. Design temperature of the boiler; they are located at the front and at the rear of the steam drum

8-57. By what means is the steam drum of a sectional header boiler connected to (A) each downtake header and (B) each uptake header?
1. Short nipple to (A) and large circulator tube to (B)
2. Large circulator tube to (A) and short nipple to (B)
3. Straight generating tube to (A) and curved generating tube to (B)
4. Curved generating tube to (A) and straight generating tube to (B)

8-58. In the header-type boiler, water and steam rise through the
1. water wall riser tubes to the steam drum, and then down through the circulator tubes to the generating tubes that connect to the downtake headers
2. water wall tubes to the uptake header and then through the riser tubes that connect the uptake headers to the steam drum
3. water wall riser tubes to the downtake header, and then through the generating tubes to the superheater
4. water wall tubes to the uptake header and then through the generating tubes to the superheater tubes and steam drum

8-59. In a double-furnace boiler, under steady steaming conditions, the degree of superheat may be increased by
1. increasing the amount of oil burned in the saturated-side furnace
2. increasing the amount of oil burned in the superheated-side furnace
3. decreasing the amount of oil burned in the superheated-side furnace and in the saturated-side furnace
4. decreasing the amount of oil burned in the superheated-side furnace and increasing the amount of oil burned in the saturated-side furnace

8-60. What part of the double-furnace boiler of textbook figure 10-18 protects the superheater when the superheater side is not lighted off; and how does the part provide this protection?
1. Water screen header; by circulating cool water through the superheater tubes
2. Water wall tubes; by directing cool water to the water screen tubes
3. Gas baffles on the division wall-tubes; by preventing the saturated-side combustion gases from flowing toward the superheater tubes
4. Gas baffles on the water screen tubes; by deflecting the combustion gases away from the water screen header

8-61. The generating tubes in the double-furnace boiler of textbook figure 10-18 are mostly 1-inch tubes with a few 2-inch tubes. Where are the 2-inch tubes located and why?
1. Near the furnace to provide cooling water for protection of the smaller tubes
2. Near the superheater burners to protect the water screen tubes from the intense radiant heat
3. Between the inner and outer casings to absorb the heat from the combustion gases
4. Between the inner casing and the water wall tubes to protect the water wall tubes from the combustion gases

8-62. What effect does the combination of large tube downcomers and small tube generating tubes have on the operation of a double-furnace boiler?
1. Less operating pressure is required.
2. The superheat is easy to control.
3. Most of the heat from the escaping combustion gases is returned to the system.
4. Extremely rapid water circulation is obtained.

8-63. What is the main advantage of a double-furnace boiler?
1. Positive control of the degree of superheat
2. Slow and even water circulation
3. Recovery of combustion gas heat
4. Available saturated steam for auxiliary purposes

8-64. The double-furnace boiler has certain disadvantages and is not used in newer combatant ships because, compared to a single-furnace boiler of equal capacity, it is
1. less efficient at low firing rates
2. harder and more dangerous to operate
3. heavier, larger, and more complex
4. all the above

8-65. How are superheater tubes prevented from overheating in a single-furnace boiler with uncontrolled superheat after the boiler has been cut in on the steam line?
1. A stream of cold air is blown around the tubes at regular intervals.
2. All steam generated in the boiler is led through the superheater.
3. Boiler is cut out at regular intervals to allow cooling.
4. Boiler furnace is kept at a low constant temperature.

8-66. A cold single-furnace boiler without controlled superheat and without connections for protective steam is being lighted off. What procedure is used to establish adequate flow of steam without damage to the superheated tubes?
1. Low firing rates
2. Low firing rates and venting the superheater drains to the bilges
3. High firing rates along with steam from another boiler
4. High firing rates and venting the superheater drains to the bilges

● Items 8-67 through 8-69 pertain to the D-type boiler.

8-67. How does an increase in rate of combustion affect the degree of superheat?
1. If there is an increase in combustion rate there is a corresponding increase in degree of superheat.
2. It has no affect on the degree of superheat until near full power; it will then cause a steady increase in degree of superheat.
3. It will cause an increase in superheat until near full power; then there will be a slight decrease in degree of superheat, even as the rate of combustion increases.
4. It has no affect as long as the feed temperature remains constant.

8-68. If a boiler is being fired at a constant rate, and steam is being used at a constant rate, what effect if any, will an increase in temperature of the incoming water have on the degree of superheat, and why?
1. The degree of superheat increases, because there will be increased heat transfer.
2. The degree of superheat decreases, because more saturated heat is generated thus causing an increase in the rate of flow through the superheater.
3. The degree of superheat increases, because the quantity of saturated steam will increase, thus causing an increase in the amount of heat available for transfer.
4. The degree of superheat will remain the same, because the rate of flow through the superheater will not be affected.

8-69. How is the superheater outlet temperature affected by the accumulation of soot on the outside of the (A) superheater tubes (B) water screen tubes?
1. Decreases as a result of either condition
2. Increases as a result of either condition
3. (A) decreases; (B) increases
4. (A) increases; (B) decreases

8-70. The overall plant efficiency is better with a single-furnace boiler than with a double-furnace boiler because the single-furnace boiler
1. supplies superheated steam at a high steaming rate and the double-furnace boiler does not
2. has controlled superheat and the double-furnace boiler does not
3. supplies superheated steam at a low steaming rate and the double-furnace boiler does not
4. has a lower operating temperature than the double-furnace boiler

8-71. One basic difference between newer and older single-furnace boilers is that the newer ones are designed for a
1. greater number of service hours without refueling
2. slower rate of heat transfer
3. greater ease of maintenance
4. higher rate of heat transfer to generating tubes

8-72. The forced flow boiler is essentially the same as the forced recirculation boiler except that the former uses an external pump to force the water through the boiler circuits and more water is supplied to it than to the forced recirculation boiler.

8-73. An advantage of the forced circulation boiler over the natural circulation boiler is that the former
1. responds more rapidly to changes in load
2. is dependent on the differences in water and steam in circulation control
3. has a larger water capacity
4. operates without a steam drum

8-74. What two basic components comprise the supercharger of recently developed pressurized-furnace boilers?
1. A steam drum and furnace
2. Generating tubes and an air compressor
3. An air compressor and a gas turbine
4. U-shaped steam tubes and headers

8-75. The main advantages of using a pressurized-furnace boiler instead of a conventional boiler of equal capacity include
1. increased efficiency, and smaller and lighter in weight
2. better maneuverability and control
3. less maintenance and shorter start-up time
4. all of the above

Assignment 9

Propulsion Boilers (continued); Boiler Fittings and Controls

Textbook Assignment: Pages 261 - 281

Learning Objective: Define terms used to describe the water in a steam-water cycle. Textbook pages 261 and 262.

The following alternatives are for items 9-1 through 9-4.

1. Boiler feed
2. Boiler water
3. Makeup feed
4. Distillate

9-1. All water in the steam-water cycle begins as

9-2. Water from the ship's distilling plant that is used as a replacement for water lost from the closed steam-water cycle is referred to as

9-3. Water between the deaerating feed tank and boiler of a propulsion plant is known as

9-4. Water actually contained within a boiler is called

9-5. What is the condition of sea water after it passes through a ship's distilling plant?

1. Pure; requiring no further treatment
2. Diluted; requiring additional treatment
3. Contaminated; with the basic impurities of salts removed
4. Free of all contaminants except calcium

9-6. Deaerated boiler feed differs from condensate mainly in that the former

1. is free of all contaminants
2. is essentially free of salts
3. contains large amounts of dissolved gases
4. contains practically no dissolved gases

Learning Objective: Point out effects of waterside deposits, waterside corrosion, and carryover on a steam propulsion plant. Textbook pages 262 through 264.

9-7. Corrosion deposits, sludge, and scale in boiler tubes cause the tubes to

1. oxidize
2. vibrate
3. overheat
4. become brittle

9-8. A general deterioration of metal over the entire interior surface of a boiler tube is caused by

1. excessive chloride content of the boiler water
2. excessive boiler water alkalinity
3. insufficient boiler water alkalinity
4. any of the above conditions

9-9. Which of the following conditions is likely to cause severe damage to the superheater?

1. Priming
2. Water free steam
3. Low chloride content
4. Each of the above

9-10. What causes severe foaming of the boiler water, and what usually occurs as a result?

1. High water alkalinity which causes general corrosion on the water side of the tubes
2. Excessive dissolved or suspended solid matter which causes carryover
3. Excessive chloride content which causes general corrosion
4. High dissolved oxygen content which causes severe pitting on the water side of the tubes

Learning Objective: Recognize principles of water testing and water treatment. Textbook pages 262 through 265.

9-11. Who establishes the frequency of shipboard boiler and feed water testing and the allowable limits of contamination?
1. Ship's commanding officer
2. Ship's engineer officer or commanding officer
3. Naval Ship Systems Command
4. Ship's engineer officer

9-12. A high concentration of chloride ions in boiler water indicates excessive
1. hardness due to dissolved salts
2. solid matter content
3. alkalinity due to certain impurities
4. all of the above

9-13. The concentration of phosphates in boiler water is measured in units of
1. pH number
2. milliliters per liter
3. parts per million
4. equivalents per million

9-14. By keeping the phosphate content of boiler water within specified limits, you control the
1. hardness
2. pH value
3. alkalinity
4. chloride content

9-15. How do you obtain the total amount of dissolved solids in boiler feed water and what unit of measure do you use?
1. By a chemical test and expressing the results in parts per million
2. By measuring the electrical conductivity of the water and expressing the results in micromhos
3. By measuring the viscosity of the water and expressing the results in a pH number
4. By a chloride test and expressing the results in micromhos

9-16. Although most of the impurities contained in feed water find their way into the boiler, the concentration of these impurities in the boiler is reduced greatly by operating the boiler and generating steam.

9-17. To prevent deterioration of a boiler under continuous steaming it is essential to
1. treat the boiler water chemically
2. use blowdown at regular intervals
3. maintain the incoming feed water as pure and free of dissolved oxygen as possible
4. do all of the above

9-18. Boiler water is treated to control
1. carryover
2. waterside deposits
3. waterside corrosion
4. all the above

9-19. Although "waterside" corrosion cannot be completely eliminated in a boiler, it can be kept at a minimum by
1. controlling water alkalinity and keeping the water as free of dissolved oxygen as possible
2. keeping water alkalinity below pH7 and the dissolved oxygen proportional to the water alkalinity
3. keeping the hardness of the water at a point where soap will lather readily
4. treating the incoming water with phosphate at regular intervals

9-20. Deleted.

Learning Objective: Apply general principles of combustion to fuel oil in a boiler furnace and identify factors that contribute to heat loss. Textbook pages 265 through 267.

9-21. What must be done to fuel oil to obtain efficient combustion in the boiler furnace?
1. Free it of all air before it enters the furnace
2. Cool it for atomization
3. Mix it with combustion air under pressure before it passes through the atomizer
4. Heat it for atomization and force it into the furnace under pressure

9-22. What elements form the main combustible components of fuel oil?
1. Sulfur and oxygen
2. Carbon and nitrogen
3. Hydrogen and carbon
4. Nitrogen and hydrogen

9-23. What is the main source of oxygen for the efficient combustion of the fuel oil in a boiler furnace?
1. Fuel oil itself
2. Atmospheric air
3. Feed water
4. An oxygen tank

9-24. As fuel oil burns in a boiler furnace, which element does not contribute to the total amount of heat released?
1. Nitrogen
2. Hydrogen
3. Carbon
4. Sulfur

9-25. What component of fuel oil releases the greatest amount of heat when combined with oxygen during combustion?
1. Carbon
2. Nitrogen
3. Hydrogen
4. Sulfur

9-26. Approximately how much oxygen is theoretically required for the complete combustion of one pound of fuel oil in the boiler furnace?
1. 1.52 lb
2. 2.67 lb
3. 3.24 lb
4. 4.32 lb

9-27. Which of the following conditions accounts for most of the heat loss during the combustion of fuel in a boiler?
1. Difficulty of oxidizing carbon completely
2. Moisture contained in the fuel
3. Moisture resulting from the oxidation of fuel
4. Heat carried away by combustion gases

9-28. Assume that a boiler furnace is operating at a fairly low temperature because the carbon in the fuel is being converted to carbon monoxide. What should you do to correct this condition?
1. Make sure the air preheater is operating at maximum efficiency.
2. Admit sufficient air in properly regulated quantities to ensure complete combustion.
3. Shut down the supply of air to make combustion less complete.
4. Try to reduce the amount of moisture in the fuel.

Learning Objective: Point out the personnel required for fireroom operation and their responsibilities. Textbook pages 267 through 269.

9-29. The fireroom watch must keep close control over which input in order to produce steam as an output?
1. Boiler water level
2. Fuel oil pressures and temperatures
3. Combustion air flow
4. All of the above

9-30. Besides the petty officer in charge and one or more messengers, who are normally the fireroom watchstanders for one manually operated boiler?
1. Checkman and burnerman
2. Checkman and blowerman
3. Burnerman and blowerman
4. Checkman, burnerman and blowerman

9-31. Which man on the fireroom watch is responsible for the proper water level in the boilers?
1. Burnerman
2. Checkman
3. Blowerman
4. Man responsible for checking auxiliary machinery

9-32. Suppose the firing rate for a manually operated boiler is decreased and the water level has dropped. What should the checkman do to maintain the proper water level?
1. Continue to feed water at the same rate.
2. Feed more water.
3. Feed less water.
4. Stop the flow of feed water temporarily.

9-33. Which of the following duties applies to the burnerman?
1. Operating the forced draft blowers
2. Opening, setting, or adjusting the air registers
3. Maintaining the proper water level in the boiler
4. Disposing of waste that may accumulate in the fireroom

9-34. Which condition in an operating boiler is indicated by a perfectly clear smokepipe?
1. Small amount of excess air for efficient combustion
2. Too much excess air for efficient combustion
3. Either of the above
4. Not enough air for efficient combustion

9-35. Which member of a fireroom watch should be excused from taking care of auxiliaries when there is a shortage of men?
1. Petty officer in charge of the watch
2. Messenger
3. Blowerman
4. Checkman

Learning Objective: Recognize the end points which limit boiler capacity and factors used in checking boiler performance. Textbook pages 269 and 270.

9-36. The sequence in which the end points of a boiler should be reached is taken into account when the boiler is designed.

9-37. The rate of firing at which the end point for combustion is reached in a boiler operating at the proper oil pressure is usually determined by the
1. number of generating tubes actually generating steam
2. capacity of the sprayer plates
3. number of downcomers
4. type of sprayer nozzle being used

9-38. The end point for water circulation is reached when the
1. downward flow of water cannot keep up with the upward flow
2. flow of air into the furnace does not permit adequate combustion of fuel
3. moisture content of steam leaving the saturated steam outlet exceeds 1 percent
4. flow of water through the generating tubes exceeds the evaporation rate

9-39. What two figures are compared when checking boiler operation during a full power run?
1. The amount of steam being generated and the amount of oil being consumed
2. The amount of oil consumed and the amount that should be consumed
3. The temperature at the saturated steam outlet and the temperature at the superheater outlet
4. The amount of steam generated at full power and the amount that should be generated at full power

9-40. What information is usually obtained by comparing the actual oil consumption with the ship's fuel performance tables?
1. Boiler load
2. Boiler efficiency
3. Plant efficiency
4. Both boiler load and boiler efficiency

Learning Objective: Recognize or apply principles of boiler casualty control. Textbook pages 271 through 275.

9-41. Total failure of the engineering plant may result when prompt action is not taken to correct minor casualties.

9-42. When is main control usually notified of a boiler casualty?
1. Before corrective action has been started
2. After the casualty has been corrected
3. At the same time corrective action is being taken
4. When all damage has been evaluated

9-43. Which of the following conditions may cause low-water casualties?
1. Failure of feed pumps
2. Rupture in feed discharge line
3. Low water in feed tank
4. Any of the above

9-44. What damage may occur when there is insufficient water to absorb the heat in a boiler furnace?
1. Distorted heating surfaces
2. Damaged brickwork
3. Warped boiler casing
4. All of the above

9-45. If water should disappear from the water gage glass, what should a Boilerman do without delay?
1. Secure the boiler.
2. Examine the glass for the presence of condensate on the inside.
3. Open the feed check valve.
4. Notify the engineroom.

9-46. What precaution should always be followed when there is a drop in steam pressure for no apparent reason?
1. Cut in additional burners.
2. Increase force draft blower speed.
3. Check the water level in the gage glasses before cutting in additional burners.
4. Check the level in the water gage glasses before increasing force draft blower speed.

9-47. One of the less obvious dangers associated with a feed pump casualty is
1. complete or partial loss of steam pressure
2. damage to the boiler
3. steam and water leaks
4. danger to fireroom personnel

9-48. Which of the following troubles is the most likely cause of inadequate discharge pressure from the main feed pump?
1. Feed stop and check valves on an idle boiler are open.
2. A turbogenerator steam stop valve is closed.
3. The cross connection valves are closed.
4. The standby main feed pump is air bound.

9-49. Which of the following conditions is likely to cause a main feed pump failure?
1. Improper setting of the speed-limiting governor
2. An inoperative constant-pressure pump governor
3. Excessive pump clearances
4. Any of the above

9-50. What must fireroom personnel do immediately when engineroom personnel cannot make the feed booster pump operate?
1. Start the emergency feed pump on cold suction.
2. Go to the engineroom and try to correct the casualty.
3. Cross-connect the feed system.
4. Secure the boiler.

9-51. What action should be taken when a casualty occurs to the emergency feed pump which is on the line during in-port operation?
1. Cross-connect the main feed system.
2. Shift the emergency feed pump to cold suction.
3. Put the standby main feed pump on the line.
4. Secure the boiler immediately.

9-52. What action should you take when all efforts fail to maintain the water level in a steaming boiler?
1. Start the emergency feed pump.
2. Cross-connect the main feed system.
3. Secure the boiler.
4. Ring the engineroom for more feed.

9-53. Which of the following harmful conditions can be caused by the presence of water in the fuel oil?
1. Damage to refractory materials
2. Clogged atomizers
3. Flarebacks
4. All of the above

9-54. In an air-encased boiler, flarebacks occur when the pressure in the furnace is greater than that in the
1. air casing
2. fireroom
3. generating tube bank
4. uptake

9-55. Which of the following practices is most likely to cause flarebacks?
1. Failing to test the drains from the fuel oil heater at regular intervals
2. Leaving disconnected atomizers in place
3. Trying to relight a burner from hot brick work
4. Raising the superheater temperature too fast after lighting off a boiler

9-56. What means may be used to increase steam flow through the superheater when unexpected low speeds occur?
1. Increase superheater fires.
2. Lift superheater safety valves by hand.
3. Adjust the steam flow indicator.
4. Do all the above.

9-57. Why should you reduce the steam pressure when a boiler pressure part has carried away?
1. To prevent further damage to the boiler and injury to personnel
2. To reduce the possibility of overloading other boilers
3. To permit an immediate evaluation of boiler damage
4. To prevent excessive use of feed water due to boiler damage

9-58. What action should be taken first if a water gage glass is accidentally broken?
1. Open the drain valve.
2. Close the top cutout valve.
3. Place a protective covering over the glass.
4. Close the bottom cutout valve.

Learning Objective: Identify boiler internal fittings and their functions. Textbook pages 276 through 281.

9-59. The internal fittings of boilers are used for all of the following except
1. feed water distribution
2. control of feed water level
3. surface blows
4. directing flow of steam and water in the steam drum

9-60. Boilers with uncontrolled superheat have an additional internal fitting known as a
1. desuperheater
2. baffle
3. steam separator
4. steam scrubber

9-61. What is the purpose of the holes in the horizontal length of the feed pipe of a header-type boiler?
1. To separate steam from the water
2. To permit the escape of impurities from the feed water
3. To reduce surging and swashing of the water
4. To allow even distribution of water along the pipe

9-62. In its removal of moisture from steam, the dry pipe of a boiler works on the principle that steam
1. travels faster than moisture
2. is heavier than moisture
3. gives up moisture when changing direction
4. will not condense on a dry pipe

● When answering items 9-63 through 9-66, refer to figure 11-1 of the textbook.

9-63. The respective inlets for feed water and superheated steam are
1. A and G
2. F and K
3. G and A
4. K and F

9-64. One of the functions of N is to
1. keep moisture and solid matter from entering the dry pipe
2. remove grease, scum, and light solids from the boiler water
3. allow water droplets to drain into the water in the steam drum
4. reduce salinity of the boiler water

9-65. Chemicals for boiler water treatment are distributed through holes in
1. B
2. C
3. E
4. L

9-66. A secondary function of M is to
1. reduce surging of the water from one end of the drum to the other
2. remove moisture and light solids from the steam
3. provide even distribution of the chemical used for boiler water treatment
4. help support the internal feed pipe and the desuperheater

9-67. Boiler chemicals are introduced into the steam drum of a double furnace boiler through the
1. chemical feed pipe
2. internal feed pipe
3. surface blow line
4. dry pipe

9-68. The basic function of a cyclone separator is to
1. remove water from steam
2. prevent violent agitation
3. increase steam velocity
4. guide steam to the dry pipe

9-69. The cyclone separator is designed to perform its function by utilizing
1. thermodynamics
2. gravity
3. centripetal force
4. centrifugal force

9-70. What part of a cyclone separator prevents the steam from being carried downward with the water?
1. Scrubber
2. Apron
3. The flat plate in the bottom of the separator
4. The internal steam baffle

9-71. Which internal fittings for the older single-furnace boiler are not found in the double-furnace boiler?
1. Nozzle plates of manifold baffle
2. Cyclone separators
3. Desuperheater tubes
4. Apron plates of manifold baffle

9-72. The knife edge on the drain baffle of a horizontal steam separator serves to
1. retain moisture
2. guide the water to the center of the drum
3. prevent steam from being carried downward with the water
4. minimize turbulence

9-73. For boiler water testing, samples of water of a newer single-furnace boiler are drawn through the
1. chemical feed pipe and nozzle
2. drain pipe
3. feed pipes
4. desuperheater inlet

● Before going on to the next assignment, make the following correction to the textbook, page 320: In the right column make the definition of g read "32.2 feet per second per second".

Assignment 10

Boiler Fittings and Controls (continued); Propulsion Steam Turbines

Textbook Assignment: Pages 283 - 327

Learning Objective: Point out the functions of boiler external fittings and connections. Textbook pages 283 through 307.

10-1. The function of the aircock located at the highest point of the steam drum of a naval boiler is to permit
1. air to escape while the boiler is being filled with water
2. air to escape when steam is first forming
3. air to enter when the boiler is emptied
4. all of the above

10-2. Generally, sampling connections are provided with coolers for the purpose of
1. cooling the connection for safe manual operation
2. condensing the steam to provide sample water
3. preventing the water from flashing into steam as it is withdrawn
4. preventing burns to persons who withdraw the water

10-3. A boiler is disconnected from the main steam line by closing the
1. main steam boiler stop
2. feed stop-check valve
3. auxiliary steam stop valve
4. feed stop valve

10-4. The two-valve boiler protection required on all ships built to U.S. Navy specifications is provided by
1. a steam stop valve in the main steam line and an auxiliary steam stop valve on top of the boiler
2. two steam stop valves in the main steam line
3. a steam stop valve in the main steam line and a check valve on the steam drum
4. two steam stop valves, one in the main steam line and one on the steam drum

10-5. Which of the following is a true statement concerning boiler safety valves, regardless of type and regardless of popping and reseating pressures?
1. Boiler safety valves are identical in design to pressure relief valves, except that boiler safety valves operate at higher pressures.
2. When a boiler is operating at maximum firing rate with all steam stop valves closed, the capacity of the safety valves must be sufficient to reduce steam drum pressure to a specified point.
3. Safety valves are installed only on boilers that operate at pressures greater than 751 psi.
4. In addition to lowering steam drum pressure to a specified point, each steam drum safety valve is designed to ensure an adequate flow of steam through the superheater when it lifts.

10-6. The accumulation of deposits on the firesides of boiler tubes can be minimized through frequent and orderly use of
1. air lances
2. steam lances
3. water lances
4. soot blowers

10-7. By what means are scum and sludge removed from the steam and water drums?
1. Both scum and sludge are removed with surface blow lines and valves.
2. Both scum and sludge are removed with bottom blow lines and valves.
3. Sludge is removed with surface blow lines and valves; scum is removed with bottom blow lines and valves.
4. Scum is removed with surface blow lines and valves; sludge is removed with bottom blow lines and valves.

10-8. The guarding valve located at the outboard bulkhead of the fireroom serves to protect the boiler blow piping against the effects of
1. combustion gases
2. salt water leakage
3. light solid matter or scum
4. heavy solid matter or sludge

10-9. What devices are used on the newer boilers for indicating the water level in the steam drum?
1. One short and one long water gage glass
2. A water gage glass and a remote indicator
3. Two water gage glasses and a remote indicator or one water gage glass and two remote indicators
4. Two water gage glasses and two remote indicators or one water gage glass and one remote indicator

10-10. Superheater temperature alarms are used on naval boilers to warn operating personnel when the superheater temperatures drop too low for efficient operation.

10-11. Special types of periscopes are fitted on naval boilers for the purpose of observing
1. water levels in steam drums
2. combustion gases passing through the uptakes
3. floors between double casings for accumulations of oil
4. both 2 and 3 above

Learning Objective: Point out some of the operating principles of boiler fittings and connections. Textbook pages 283 through 307

10-12. While steam is being raised in the boiler, superheater drains are discharged through
1. steam traps to the high pressure drain system
2. steam traps to the fresh water drain collecting system
3. gravity drains to the fresh water drain collecting system
4. gravity drains to the high pressure drain system

10-13. Under what operating conditions must the manually operated feed check valve and the feed stop valve be fully open?
1. When filling the boiler with the main feed pump
2. When filling the boiler with the emergency feed pump
3. When automatic feed water controls are installed and in use
4. When giving the boiler a routine surface blow

10-14. A safety valve on a boiler differs from a relief valve in that the safety valve
1. opens only slightly when the specified pressure is reached while the relief valve opens completely when the specified pressure is reached
2. opens slowly when the specified pressure is reached while the relief valve opens quickly with a pop when the specified pressure is reached
3. pops open completely when the specified pressure is reached while the relief valve opens only slightly when the specified pressure is reached
4. has a continuous opening and closing action controlled by a specified pressure while the relief valve opens and remains open until the pressure is slightly lower than that specified

10-15. Refer to figure 11-18 of the textbook. The respective popping and reseating pressures of the huddling chamber type safety valve are determined by the
1. size of huddling chamber and position of the compression screw
2. positions of valve spindle and compression screw
3. position of the release nut and length of the valve spindle
4. tension on the spring and position of the adjusting ring

10-16. Refer to the steam drum safety valve of figure 11-19 in the textbook. An adjustment for blowdown of a nozzle reaction type safety valve is made by changing the positions of the
1. adjusting nut and the nozzle ring
2. nozzle ring and the adjusting ring
3. disk insert and the disk holder
4. adjusting ring and the adjusting nut

10-17. How are the valves of a pressure-pilot operated superheater outlet safety valve assembly (textbook figure 11-20) operated?
1. Drum valve and actuating valve are steam and spring pressure operated; unloading valve is steam pressure operated.
2. Drum valve and unloading valve are spring and steam pressure operated; actuating valve is steam pressure operated.
3. Each valve is opened by steam pressure and closed by spring pressure.
4. Each valve is closed by steam pressure and opened by spring pressure.

10-18. Explain the operation of the Crosby two-valve superheater outlet safety valve assembly (textbook figure 11-21).
1. Steam pressure opens the drum pilot valve allowing steam to flow to and open the superheater valve; if the drum pilot valve fails to open, a slight increase in pressure will open the superheater valve.
2. Steam pressure opens the superheater valve allowing steam to flow to and open the drum pilot valve; if the superheater valve fails to open, a slightly higher pressure will open the drum pilot valve.
3. The drum pilot valve is forced open by steam pressure causing a reduction in steam pressure which permits the superheater valve to open.
4. The superheater valve is forced open by steam pressure causing a reduction in steam pressure which permits the drum pilot valve to open.

10-19. The superheater unloading valve in figure 11-22 of the textbook is closed by
1. spring pressure
2. air pressure
3. the actuating valve
4. steam pressure

10-20. Refer to figure 11-22 in the textbook. Which of the following conditions must exist before the unloading valve will close?
1. Open pilot valve and an open actuating valve
2. Closed pilot valve and an open actuating valve
3. Closed actuating valve and an open pilot valve
4. Closed pilot valve and a closed actuating valve

10-21. What medium is used in soot blowers to remove soot from boiler firesides?
1. Saturated steam
2. Superheated steam
3. Air pressure
4. Pressurized fresh water

10-22. Scavenging air is blown through the soot blower element to
1. prevent combustion gases from backing up into the soot blower head and piping
2. prevent combustion gases from backing up into the fireroom
3. prevent overheating while the element is idle
4. keep it clear of condensation

10-23. When must boiler water gages be blown down?
1. When the indicated level is in doubt
2. Before the boiler is cut in on the line
3. At the end of each watch
4. At all of the above times

10-24. To determine whether a superheater is overheating, you must know the
1. superheater outlet temperature and the difference in steam pressures at the superheater inlet and outlet
2. superheater inlet temperature and the difference in steam pressures at the superheater inlet and outlet
3. superheater inlet and outlet temperatures
4. temperatures inside the superheater and the steam pressures at the superheater inlet and outlet

10-25. The single-element automatic feed water regulator is controlled by variations in the
1. pressure at the superheater outlet
2. temperature at the superheater outlet
3. pressure in the steam drum
4. level of water in the steam drum

Learning Objective: Identify boiler controls and their operating principles. Textbook pages 307 through 318.

10-26. The inputs of fuel and combustion air to a boiler by an automatic combustion system depend on
1. feed water input
2. steam demand
3. steam drum water level
4. temperature of the superheated steam

10-27. A boiler control system must be able to
1. measure the output and correct the input
2. compare measured output with desired output
3. compute correction required to restore desired output
4. do all the above

● When answering items 10-28 through 10-33, refer to figure 11-39 in your textbook.

10-28. The position of the steam valve is affected by a change in
1. the temperature of the steam input
2. the temperature of the heated water
3. the position of the set point knob
4. both 2 and 3 above

10-29. The amount and direction of change of the steam valve is computed by the
1. steam valve and motor operator
2. nozzle-and-vane assembly
3. thermometer bulb and capillary tubing
4. Bourdon tube

10-30. Which value is represented by the position of the set point knob?
1. Actual measured temperature of the hot water output
2. Actual measured temperature of the cold water input
3. Desired temperature of the hot water output
4. Corrected temperature of the steam input

10-31. The correction requested to equalize measured output temperature and desired output temperature is a function of the distance between the
1. thermometer bulb and Bourdon tube
2. nozzle tip and vane
3. transmitter and motor operator
4. motor operator and steam valve

10-32. The heat exchange process is ultimately controlled by the
1. Thermometer bulb and Bourdon tube
2. Nozzle-and-vane assembly
3. Mechanical linkages
4. Motor operator and steam valve

10-33. The controlling force in the automatic control process of the heat exchanger is
1. steam
2. gravity
3. feed water
4. compressed air

● The following alternatives are for items 10-34 through 10-37 which concern a Bailey Boiler control system.
1. Control valve
2. Relay
3. Selector valve
4. Transmitter

10-34. What device produces a pneumatic signal proportional to one of the basic variables in the control process?

10-35. What device combines a number of input signals to produce an output signal?

10-36. What device regulates the flow of fluid in a line?

10-37. What device determines whether components that follow it will be controlled manually or automatically?

● Items 10-38 through 10-51 refer to the control relationship of the major components illustrated schematically in figure 11-41 of the textbook.

10-38. The combustion control system maintains the energy input to the boiler equal to the energy output through a feedback signal which causes readjustment of the
1. steam flow
2. combustion air flow
3. fuel flow and steam flow
4. fuel flow and combustion air flow

10-39. What are the initial signals in the Bailey combustion control system?
1. Steam pressure and steam flow
2. Steam pressure, steam flow, and fuel supply flow
3. Steam pressure, steam flow, fuel supply flow, and fuel return flow
4. Steam pressure, steam flow, fuel supply flow, fuel return flow, and combustion air flow

10-40. Assume that the pressure from each of the steam flow transmitters is applied to the selective relay. To what combustion control component does the selective relay then transmit the higher pressure?
1. C4b
2. C15
3. C4a1
4. C3

10-41. The minimum air flow demand signal is maintained at a value consistent with minimum blower speed and damper position by means of the
1. selector valves
2. rate relay
3. bias relay
4. flow transmitter

10-42. When there is a loss of control air supply, the forced draft blowers are closed to their mechanical bottom stops by the action of
1. C1a
2. C1b
3. C6a and C7a
4. C4a1 and C4a3

● Items 10-43 through 10-49 pertain to the boiler control system when there is an increase in demand for steam.

10-43. When steam flow increases, an increased steam flow signal travels from
1. C4a1 to F2
2. F2 to F1b
3. F2 to C4a1
4. F1b to F2

10-44. As steam demand increases and the forced draft blowers begin to speed up, the air flow transmitter (C3) sends
1. an increased signal to C4b and C15
2. a decreased signal to C4b and C15
3. an unchanged signal to C4a2
4. an increased signal to F6a

10-45. What happens when the steam demand increases?
1. Output of fuel flow-air flow Standatrol decreases.
2. Output of fuel flow-air flow Standatrol increases.
3. Fuel control valve opens.
4. Fuel supply to burners decreases.

10-46. The functioning of the feed-water control system is based upon
1. steam flow
2. boiler drum water level
3. feed-water flow
4. all of the above

10-47. What condition exists when the output signal of C4a3 is exactly equal to the output signal of F2?
1. Steam demand has increased.
2. Steam demand remains steady.
3. Steam demand has decreased.
4. Steam demand has ceased.

10-48. When there is an increase in steam demand, what is the first effect on the feed-water flow control valve?
1. The valve responds to an increased signal from the feed-water selector valve.
2. The valve opens wider.
3. The valve begins to close.
4. The valve responds directly to a signal from the feed-water flow transmitter.

10-49. When feed-water flow decreases, the effects of the resulting pneumatic pressure decreases from the feed-water flow transmitter are delayed by the
1. output pressure of the feed-water Standatrol
2. compensation for shrink
3. increase in firing rate
4. restricting action of the bleed valve

10-50. What is the first effect of a decreased steam demand on the feed-water flow control valve and why?
1. Larger opening to compensate for shrink
2. Smaller opening to compensate for swell
3. Maximum opening to permit maximum feed-water flow
4. Complete closing to restrict water input to the boiler

Learning Objective: Recognize the design, operating principles, and functions of steam turbine and its accessories. Textbook pages 319 through 327.

10-51. The primary function of a ship's propulsion turbines is to produce useful work through the initial conversion of
1. kinetic energy
2. chemical energy
3. mechanical energy
4. thermal energy

10-52. Which energy transformations are involved in the production of work by a ship's turbines?
1. Potential energy to thermal energy; thermal energy to work
2. Kinetic energy to thermal energy; thermal energy to work
3. Thermal energy to kinetic energy; kinetic energy to work
4. Thermal energy to potential energy; potential energy to work

10-53. Steam that passes from a high pressure area to a low pressure area when flowing through a nozzle undergoes an increase in
1. velocity
2. thermal energy
3. potential energy
4. temperature

10-54. The velocity of superheated steam flowing through a nozzle does not increase as outlet pressure decreases after the ratio of outlet pressure to inlet pressure falls below
1. 0.85
2. 0.75
3. 0.65
4. 0.55

10-55. The purpose for using a nozzle of the convergent-divergent type design is to
1. reverse the direction of steam flow
2. control turbulence of the steam under certain conditions
3. increase the velocity of the steam
4. control the pressure of the steam

10-56. If 250 pounds of steam leaves a nozzle at a velocity 20 feet per second, what is its kinetic energy?
1. 388.20 ft-lb
2. 776.40 ft-lb
3. 1552.80 ft-lb
4. 2500.00 ft-lb

10-57. A nozzle increases the kinetic energy of exiting steam by an amount directly proportional to the
1. square of the steam velocity
2. cube of the steam velocity
3. square root of the steam velocity
4. cube root of the steam velocity

10-58. What basic part of a turbine converts energy to work?
1. Rotor
2. Casing
3. Nozzle
4. Blade

10-59. A reactive force is developed in an impulse turbine because the steam
1. begins to condense
2. enters a vacuum
3. becomes turbulent
4. changes direction

10-60. In a simple turbine, the theoretical relative velocity of steam at the blade exit is equal to the
1. absolute velocity of steam at the blade entrance minus the absolute velocity of steam at the blade exit
2. absolute velocity of steam at the blade exit plus the relative velocity of steam at the blade entrance
3. absolute velocity of steam at the blade entrance minus the peripheral velocity of the blade
4. relative velocity of steam at the blade entrance plus the peripheral velocity of the blade

10-61. What factors determine the amount of work obtained from an actual impulse turbine?
1. Velocity of blade
2. Angle of steam entrance
3. Velocity of entering steam
4. All of the above

10-62. Assume the maximum work obtainable from the flat vanes in textbook figure 12-3 is x. Theoretically, by replacing the vanes with the curved impulse blades shown in textbook figure 12-4, the maximum work obtainable is
1. 1/2x
2. 2x
3. 3x
4. 4x

10-63. Compare the change in steam pressure and steam velocity as it passes through the blades of an impulse turbine.
1. The pressure is the same at the entrance and exit of the blade, whereas velocity decreases as the steam passes through the blades.
2. Velocity remains constant whereas pressure decreases slightly as the steam passes through the blades.
3. Both pressure and velocity decrease as the steam passes through the blades.
4. Both pressure and velocity increase as the steam passes through the blades.

10-64. Reaction occurs whenever steam leaves a nozzle at a
1. speed greater than its entrance speed
2. density lower than its entrance density
3. pressure greater than its entrance pressure
4. temperature lower than its entrance temperature

10-65. The force exerted by steam in a reaction turbine is produced by
1. reaction due to change in direction of steam flow
2. reaction due to increase in steam velocity
3. impulse due to impact of steam on the moving blades
4. all of the above

10-66. To convert the major portion of available energy into work in modern naval ships, steam turbines are provided with
1. a single row of blades
2. multiple rows of blades
3. a set of nozzles for each row of blades
4. one row of fixed blades and several rows of movable blades

10-67. A simple impulse stage differs from a reaction stage in that the latter consists of
1. a nozzle and one row of fixed blades
2. one row of moving blades and one row of fixed blades
3. a nozzle; one row of fixed blades and one row of movable blades
4. one row of fixed blades and two or more rows of moving blades

10-68. The difference between a simple impulse turbine and a velocity-compounded impulse turbine is that the latter
1. rebuilds pressure lost in the nozzles
2. expands steam through a multiple set of nozzles
3. obtains higher efficiency by increasing blade speed
4. has two or more rows of moving blades in a single stage

10-69. The velocity-compounded impulse stage is usually called a
1. Ljungstrom stage
2. Rateau stage
3. Curtis stage
4. Westinghouse stage

10-70. The primary difference between a velocity-compounded impulse turbine and a pressure-compounded impulse turbine is that the latter
1. combines fixed and moving blades
2. causes a steam pressure drop across the blades
3. uses more than one set of nozzles
4. causes a steam velocity increase in the nozzles

10-71. Turbines are classified according to all of the following characteristics except
1. division of flow
2. repetition of flow
3. location of flow
4. direction of flow

10-72. Most main propulsion turbines aboard naval vessels are of the
1. single-entry axial flow type
2. single-entry radial flow type
3. re-entry axial flow type
4. re-entry radial flow type

10-73. What is an advantage of a double-flow turbine over the single flow?
1. Two-direction steam flow prevents axial thrust.
2. Steam enters at the throttle end for operation efficiency.
3. Steam passes through the blading only once.
4. Blades can be longer for more power than a single flow of equal capacity.

Assignment 11

Propulsion Steam Turbines (continued); Condensers and Other Heat Exchangers

Textbook Assignment: Pages 328 - 360

Learning Objective (continued): Recognize the design, operating principles, and functions of steam turbine and its accessories. Textbook pages 328 through 336.

11-1. Class A is a type of propulsion turbine used in
1. submarines
2. patrol ships
3. auxiliary ships
4. amphibious warfare ships

The following alternatives are for items 11-2 through 11-5.
1. Type III propulsion unit
2. Type IV propulsion unit
3. Type II-A propulsion unit
4. Type II-C propulsion unit

11-2. In which unit is the steam admitted to the high pressure turbine and then flows straight through the turbine without bypassing any stages, and exhausts to the low pressure turbine through a crossover pipe?

11-3. Which unit is similar to the type II-A unit except that it is capable of bypassing steam from the first-stage shell around the next stage (or next few stages) of the high pressure turbine at speeds higher than the most economical speed?

11-4. Which unit consists of three ahead elements and bypasses no ahead blading during ahead operation?

11-5. In which unit can the high pressure turbine be operated while the cruising turbine is disconnected for repairs?

11-6. Which characteristic is common to turbo-electric propulsion units, but not to geared turbine propulsion units?
1. A number of turbines for delivering power to the same shaft
2. A single turbine for each shaft
3. Direct drive installation
4. An astern element for backing or reversing

11-7. To permit expansion and contraction, a turbine is usually installed aboard ship by securing
1. the forward end rigidly to the foundation and allowing some freedom of movement to the after end
2. both ends in separate grooves allowing independent movement to each end
3. both ends to a sliding sunken plate allowing the turbine to move as a unit
4. the after end rigidly to the foundation and allowing some freedom of movement to the forward end

11-8. The turbine is protected from the direct force of expansion of the steam line by
1. a flexible I-beam at the base of the turbine
2. expansion bolts at the base of the line
3. curvatures in the steam line
4. baffle plates set against the outer casing

11-9. To permit access for inspection and repair, turbine casings are
1. split vertically
2. split horizontally
3. fitted with flanged expansion-removable plates
4. provided with manholes and steam tight metal-to-metal covers

11-10. How is speed control effected on modern ships that use nozzle control valve arrangements instead of throttling valves for admitting steam to the turbine?
1. By varying the number of nozzle valves that are open
2. By controlling the openings of the nozzle valves in use
3. By using partial arc admission of steam
4. By varying the steam admission between partial arc and full arc admission

11-11. The turbine's sleeve bearings perform which of the following functions?
1. Facilitating installation
2. Preventing excessive loading per unit area
3. Maintaining correct radial clearance between rotor and casing
4. All of the above functions

11-12. Turbines are equipped with shaft glands to reduce
1. oil leakage
2. air leakage
3. oil and steam leakage
4. air and steam leakage

11-13. Differentiate between the suitability of carbon packing and labyrinth packing used in shaft glands.
1. Carbon packing is suitable only for low pressure and temperature areas whereas labyrinth packing is suitable in high pressure and temperature areas.
2. Labyrinth packing is suitable only for low pressure and temperature areas whereas carbon packing is suitable for high pressure and temperature areas.
3. Carbon packing is suitable for high pressures at low temperatures whereas labyrinth packing is suitable for high pressures at any temperature.
4. Labyrinth packing is suitable for high pressures at low temperatures whereas carbon packing is suitable for high pressures at any temperature.

11-14. The function of the gland sealing steam system is to prevent air from entering the turbine by
1. maintaining a higher-than-air pressure in the packing glands
2. furnishing sufficient heat to change air into steam in the packing glands
3. condensing steam into water in the packing glands
4. reducing the velocity and pressure of the air by an eddy in the packing glands

11-15. The dummy piston and cylinder in a single flow reaction turbine serves to
1. balance the rotor
2. reduce thrust
3. equalize pressure
4. absorb excess steam

11-16. In relation to each other, under which conditions of speed do turbines and propellers operate most efficiently?
1. High speeds for both
2. Low speeds for turbines; high speeds for propellers
3. High speeds for turbines; low speeds for propellers
4. Low speeds for both

11-17. What is the function of the jacking gear in geared turbines?
1. To rotate the turbine without using steam
2. To ensure even heating and cooling of the rotor during securing and warm-up
3. To bring the reduction gear teeth into view for routine inspection
4. To perform all of the above functions

Learning Objective: Point out principles and practices in the operation, maintenance, and casualty control of a ship's propulsion plant. Textbook pages 336 through 347.

11-18. Under which of the following conditions is a ship considered reliable?
1. Its machinery is in excellent condition.
2. It is capable of meeting all scheduled operations.
3. Its machinery is in good condition, and it has a well organized and effective maintenance program.
4. It meets all scheduled operations and is capable of accepting unscheduled tasks.

11-19. Which of the following performance data records may be used in determining the ship's engineering plant economy underway?
1. Fuel oil consumption per mile
2. Makeup feed per mile
3. Potable water per man per day
4. All of the above

11-20. Economical operation of the engineering plant is very important, but economy may be sacrificed to ensure
1. above-standard factors affecting the health of the crew
2. above-standard factors affecting the comfort of the crew
3. good engineering practices
4. both 1 and 3 above

11-21. All the following factors will lower the economical operation of an engineering plant except
1. maintaining a high condenser vacuum
2. maintaining a low condenser vacuum
3. rapid acceleration of the main engines
4. failing to maintain a constant boiler steam pressure

11-22. Fluctuations in steam pressure above or below the engineering plant design pressure are often desirable and are important in the interest of efficiency and economy.

11-23. Fast acceleration of the main engines affect the economy of the propulsion plant by
1. wasting fuel oil
2. wasting steam
3. causing excessive temperatures
4. doing all the above

11-24. The purpose of the acceleration and deceleration charts posted at each main engine throttle board is to provide the throttleman with the
1. pressure and temperature relationship at the various speed levels (one-third speed, two-thirds speed etc)
2. number of rpm each shaft is doing at the various speed levels (one-third speed, two-thirds speed etc)
3. exact amount of time he should use in changing speed
4. amount of time it takes the turbines to accelerate or decelerate the ship to the new speed set by the throttleman

11-25. To promote efficient plant operation, and to aid watchstanding, each throttleman is advised to
1. check the tachometers frequently and keep a record of the readings
2. provide his relief with a record of the speed changes during his watch and the respective rpm of the shaft
3. use a revolution-pressure table which gives the approximate pressure required in the first stage of the high pressure turbine to develop a certain rpm
4. do all the above

11-26. Before relieving the watch, a throttleman should make sure that he knows the
1. requirements of the Oil Pollution Act of 1961
2. number of rpm required to develop certain pressures in the high pressure turbine
3. number of rpm for the various speeds (one-third speed, two-thirds speed etc)
4. amount of time required for the turbines to accelerate or decelerate from one speed level to another

11-27. The precautions which should be taken to maintain a high vacuum in the main condenser of a ship underway include
1. eliminating all air leaks into the condensing system
2. keeping gland packing in good condition
3. maintaining adequate water in the reserve feed tank which is in use for makeup feed
4. all the above

11-28. When a ship has a cruising turbine, at what speeds should you request to operate on cruising combination for underway operations requiring steady speeds?
1. Eighteen knots and above
2. All speeds less than 18 knots
3. Between 20 and 25 knots
4. All speeds less than 25 knots

11-29. In the interest of efficient ship operation, the Engineering Officer of the Watch must acquaint himself with all standing orders, and the operating instructions for his ship which show the various plant arrangements for the different speeds.

11-30. In most installations, boiler superheaters cannot safely be fired unless there is a safe minimum flow of steam passing through the superheaters. What is the usual necessary speed of destroyers for safely lighting fires under the superheat side of the boiler?
1. 8 knots
2. 10 knots
3. 12 knots
4. 14 knots

11-31. Which of the following conditions is the most direct effect of the repeated lighting off and securing of the superheater on a superheat-control boiler?
1. Excessive consumption of fuel resulting from uneven superheat temperatures
2. Excessive production of steam resulting from extreme temperature conditions
3. Steam leaks resulting from extreme superheat pressures
4. Steam leaks resulting from fast changing temperature conditions

11-32. Although the single-furnace boiler creates no special problem during operation, there is a problem when lighting off and securing the boiler because
1. all steam must pass through the superheater
2. flow of steam through the superheater is not adequate
3. the temperature of the superheater tubes is excessively low
4. boiler pressure is at a minimum

11-33. On a ship that has superheat control boilers, what is the maximum permissible outlet temperature of the steaming boilers for cutting in an additional boiler without its superheater in operation?
1. 200° F
2. 400° F
3. 600° F
4. 800° F

11-34. The maximum rate of change in superheat temperature during normal operation should not exceed
1. 25° F in 5 minutes
2. 25° F in 10 minutes
3. 50° F in 5 minutes
4. 50° F in 10 minutes

11-35. Which of the following steps should be taken first if the temperature of a bearing increases above its normal running temperature?
1. Check for dirt or grit in the bearing.
2. Stop the machinery involved.
3. Check the quality and quantity of the lube oil.
4. Spray water on the bearing casing.

11-36. What is the effect of maintaining too high an operating water level in the deaerating feed tank?
1. Possible damage to the main feed booster pumps
2. Possible damage to the main feed pumps
3. Loss of feed pressure
4. Air and noncondensable gases in the feed water

11-37. Preventive inspections and maintenance are important to casualty control because they are effective means for keeping casualties, especially those caused by material failures, at a minimum.

11-38. A function of engineering casualty control that contributes significantly to the accomplishment of its mission is to minimize
1. personnel casualties
2. secondary damage to vital machinery
3. the cost of operating engineering equipment
4. both 1 and 2 above

Learning Objective: Point out operating principles and construction features of main condensers and other heat exchangers of a conventional steam turbine propulsion plant. Textbook pages 348 through 356.

11-39. The main condenser of a conventional steam turbine propulsion plant is the part that functions to
1. control the temperature of the working steam
2. remove the heat from circulating sea water
3. cool exhaust steam and to recover and return feed water to the feed system
4. cool and to vent used steam to the atmosphere

11-40. What is the approximate design vacuum of a main condenser, and what operational factor may cause this vacuum to vary?
1. 10 to 15 inches of mercury; load on the condenser
2. 15 to 20 inches of mercury; temperature of the outside sea water
3. 20 to 25.5 inches of mercury; load on the condenser and tightness of the condenser
4. 25 to 28.5 inches of mercury; load on the condenser, temperature of the outside sea water; or tightness of the condenser

11-41. The thermodynamic efficiency of a steam plant in which the condenser is maintained under vacuum is increased as a consequence of
1. increasing the difference between the boiler temperature and the condenser temperature
2. decreasing the difference between the boiler temperature and the condenser temperature
3. increasing the condenser temperature and stabilizing the boiler temperature
4. decreasing the boiler temperature and stabilizing the condenser temperature

11-42. The condensation of steam in a tight condenser results in a vacuum because the specific volume of steam is far greater than that of water.

11-43. In a modern shipboard steam plant, the functions of the air ejectors include
1. removing noncondensable gases from the condenser
2. helping establish initial vacuum in the condenser
3. helping maintain vacuum while the plant operates
4. all the above

11-44. Vacuum developed in the condenser of a ship operating in warm waters is higher than the vacuum developed in the condenser of the same ship operating in cold waters.

11-45. Noncondensable gases are removed from the vapor-condensate circuit of the main condenser through the
1. ejector scoop
2. steam exhauster
3. condensate pump suction
4. air ejector suction opening

11-46. What device provides circulating sea water for the main condenser when the ship is underway and when at anchor, respectively?
1. Condensate pump; scoop injector
2. Scoop injector; circulating pump
3. Circulating pump; vent manifold
4. Vent manifold; condensate pump

11-47. Main condensers equipped with scoop injection are of a type described as
1. curved-tube, single-pass
2. straight-tube, single-pass
3. straight-tube, double-pass
4. curved-tube, double-pass

11-48. What is the purpose of the lubricated sliding feet when used with a main condenser?
1. To compensate for expansion and contraction differentials between the shell and the condenser supporting structure
2. To provide a partition between the vapor-condensate circuit and the circulating water circuit
3. To decrease the pressure around the copper-nickel alloy tubes
4. To provide greater efficiency in water circulation through the condenser

11-49. What is an indication that a condenser is operating efficiently?
1. Low condensate depression
2. High condensate depression
3. Low temperature differential between the boiler and the condenser
4. Low steam pressure differential between the boiler and the condenser

11-50. Air and steam are separated in main condensers by means of
1. air ejectors
2. baffle arrangements
3. condenser tubes
4. crossover pipes

11-51. Which of the following types of energy can you disregard or omit when evaluating the performances of an actual condenser?
1. Mechanical kinetic energies of the entering and leaving sea water, of the leaving condensate, and of the entering steam
2. Thermal energies of the entering steam and sea water
3. Thermal energies of the leaving sea water and condensate
4. Thermal energies of the leaving condensate, of entering and leaving sea water, and of the entering steam

11-52. What type of pump is used to remove air from a condenser?
1. Positive displacement pump
2. Jet pump
3. Centrifugal pump
4. "Wet" air pump

11-53. The direction of flow through the loop seal of a two-stage air ejector assembly is from the
1. inter condenser to the after condenser
2. main condenser to the inter condenser
3. inter condenser to the main condenser
4. main condenser to the after condenser

11-54. In the second stage of a 2-stage air ejector, air is vented from the after condenser to the
1. atmosphere
2. gland exhaust system
3. vent condenser
4. main condenser

11-55. Heat is removed from the steam in the gland exhaust condenser by
1. sea water
2. cool fresh water
3. air
4. condensate

11-56. To prevent a loss of vacuum maintained by the air ejectors in the main condenser, some condensate is recirculated to the main condenser before reaching the deaerating feed tank to prevent overheating of the air ejectors.

11-57. Steam from the steam-air mixture in the vent condenser is cooled and condensed by
1. sea water
2. fresh feed water
3. condensate from the main condenser
4. superheated steam from the gland exhaust condenser

11-58. Auxiliary exhaust steam is used to heat the water in the
1. inter condenser
2. gland exhaust condenser
3. deaerating feed tank
4. loop seal

11-59. What means is used for removing dissolved oxygen from the water droplets in the deaerating feed tank of the textbook figure 13-5?
1. Air-free steam
2. Cone-shaped baffles
3. Condensate from the main condenser
4. Air pressure

11-60. Deaerated water from the deaerating tank is pumped to the
1. main condenser by the feed booster pump
2. boilers by the feed booster and main feed pumps
3. inter condenser by the main feed pump
4. economizer by the feed booster or main feed pump

11-61. What is the purpose for recirculating water from the main feed pump discharge back to the deaerating feed tank?
1. To maintain a constant discharge pressure under all load conditions
2. To provide a positive suction pressure for the main feed pump
3. To cool the air ejector condensers
4. To protect the main feed pump from overheating

Learning Objective: Recognize principles and engineering practices in controlling casualties in a conventional steam turbine propulsion plant. Textbook pages 356 through 358.

In items 11-62 through 11-65 select from column B the condition that brings about or contributes to the major cause of vacuum loss in column A.

A. Major Causes	B. Conditions
11-62. Improper drainage of condensate from the condenser	1. Vent valve on the idle condensate pump is open
11-63. Excessive air leakage into the vacuum system	2. Air ejector nozzles are clogged with foreign matter
11-64. Improper functioning of the air removal equipment	3. Condensate pump's speed-limiting governor is malfunctioning
11-65. Insufficient flow of circulating water	4. Air is trapped in the condenser

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11-66. Your investigation to determine the cause of a salty condenser should include checking for
1. leaky condenser tubes
2. low pressure drain tank and make-up feed tank
3. leaky feed suction and drain lines that run through the bilges
4. all the above

11-67. Which of the following steps should be taken if a leak develops in the ship's condenser?
1. Isolate the condensate system and limit the number of boilers on the engine involved.
2. Shift the turbogenerator exhaust drains to the auxiliary condenser.
3. Stop the engine involved.
4. Test the condenser.

11-68. Unstable operation of air ejectors may be caused by
1. low steam pressure
2. wet steam
3. clogged nozzles
4. all of the above

11-69. The quenching of a deaerating feed tank is caused by
1. a loss of a main condensate pump
2. an open auxiliary exhaust augmenting valve
3. a loss of the main feed pump
4. an excessive amount of cold water entering the tank suddenly

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Learning Objective: Point out safe practices to follow when opening a main condenser for cleaning, inspection, or testing. Textbook pages 358 through 360.

11-70. Safety precautions pertaining to steam condensers in the engineering plant include
1. keeping at least 15 psig pressure in the sea water chest
2. avoiding metal contact with the zincs
3. ensuring that no open flame or sparking object is near a condenser being opened
4. keeping air pressure in the salt water sides of condensers that are in use

11-71. In the interest of safety, when a loss of vacuum occurs in a hot condenser you should
1. increase the pressure in the sea water chest
2. close all sea connections
3. slow down or stop the engine
4. partly close the sea suction line valve

11-72. To test the main circulating pump bilge suction it is usually necessary to
1. open the bilge suction line stop or check valve
2. close down the sea suction line valve until maximum bilge suction capacity is obtained
3. start the main circulating pump
4. do all the above

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